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Comparative Analysis of the Effectiveness of Expanded Polystyrene (EPS) Blocks and Concrete Hollow Blocks (CHBs) for Building Construction in the Philippines Using Compressive Strength Test and Water Absorption Test

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***Abstract*—This study presents a comparative analysis of Expanded Polystyrene (EPS) blocks and Concrete Hollow Blocks (CHBs) for building construction in the Philippines, focusing on compressive strength and water absorption characteristics. The research aims to evaluate and compare the performance of EPS blocks and CHBs through standardized testing methods, with the objective of determining which material offers superior structural and durability attributes in the context of the Philippines' construction needs. Statistical analysis, including t-Test, confirmed that the differences in both compressive strength and water absorption between the two materials are statistically significant, with p-values well below the 0.05 threshold. These results support the hypothesis that EPS blocks offer enhanced performance over CHBs in terms of strength and durability. The findings indicate that EPS blocks are a more effective choice for construction in the Philippines, given their superior compressive strength and moisture resistance. This study highlights the potential benefits of using EPS blocks in improving the resilience of building structures, particularly in regions prone to natural disasters such as earthquakes and heavy rainfall.**

Keywords—Expanded Polystyrene (EPS) Blocks, Concrete Hollow Blocks (CHBs), Compressive Strength, Water Absorption, Construction Materials in the Philippines

I. INTRODUCTION

The Philippines is highly prone to natural disasters due to its geographic location and geological characteristics. It is situated in the Pacific Ring of Fire, where tectonic plates converge, resulting in frequent earthquakes and volcanic activity. Moreover, the Philippines is frequently affected by tropical cyclones, landslides, floods, and other weather-related hazards.

The impact of natural disasters on the built environment is significant, leading to loss of life, damage to infrastructure, and disruption of communities. The construction industry plays a crucial role in mitigating these risks by employing resilient building materials and designs that can withstand the forces exerted by natural disasters.

Concrete Hollow Blocks (CHBs) have traditionally been the standard choice in Philippine construction due to their widespread availability, cost-effectiveness, and proven structural performance. CHBs are valued for their strength, durability, and capacity to withstand various environmental stresses. However, with the increasing emphasis on sustainability, energy efficiency, and innovation in construction materials, Expanded Polystyrene (EPS) blocks have emerged as a notable alternative. EPS blocks are lightweight, offer excellent thermal insulation, and are relatively easy to handle, making them an attractive option for modern construction.

An insightful research study conducted by [1-4] examined the efficiency and durability of expanded polystyrene (EPS) blocks in building construction. The researchers performed a series of tests to evaluate the blocks' resistance to environmental stressors, including freeze-thaw cycles, moisture penetration, and chemical exposure. Through meticulous analysis, [1] [5-8] found that EPS blocks demonstrated remarkable durability, showing minimal signs of degradation or structural compromise even after prolonged exposure to harsh conditions. The incorporation of expanded polystyrene beads in the mix contributes to the blocks' ability to withstand environmental challenges, as the air pockets within the material act as insulating barriers, reducing the impact of freeze-thaw cycles and preventing moisture-induced damage. Furthermore, the study highlighted the blocks' resistance to chemical attacks, making them suitable for applications in areas prone to corrosive agents. The results of this research provide compelling evidence for the efficiency and long-term durability of EPS blocks, presenting them as a viable and sustainable building material choice for various construction projects [9-10].

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This study aims to address this gap by conducting a comparative analysis of EPS blocks and CHBs. The analysis will focus on two critical performance metrics: compressive strength and water absorption. Compressive strength is a measure of a material's ability to withstand axial loads without failure, which is crucial for maintaining structural integrity under load. Water absorption is an important factor that affects a material's durability, as high water absorption can lead to weakened structural performance and reduced longevity [11-15].

II. METHODOLOGY

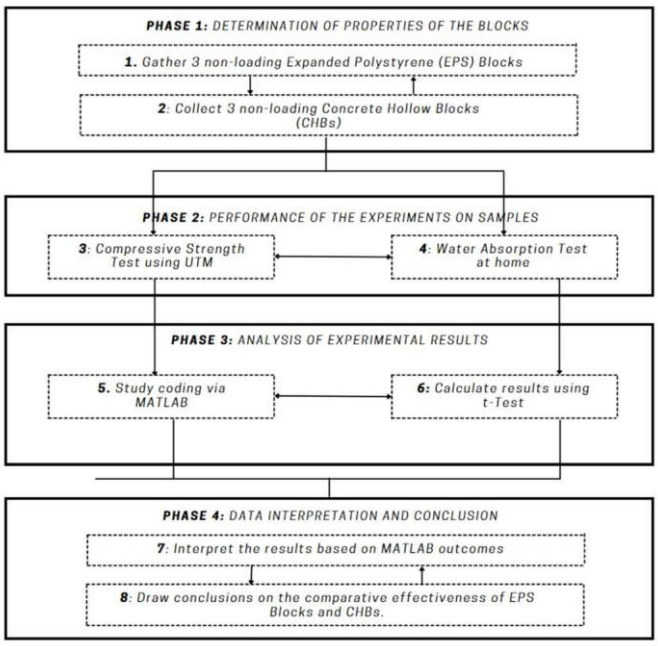


Fig. 1. Flowchart of the Data Collection and Computation

The study begins with the determination of properties for the two types of blocks under investigation: Expanded Polystyrene (EPS) Blocks and Concrete Hollow Blocks (CHBs). In this phase, both EPS Blocks and CHBs are collected and thoroughly assessed to understand their physical and material characteristics, providing a foundational baseline for the comparative analysis. Following this, the performance of the blocks is tested through two primary experiments: a Compressive Strength Test using a Universal Testing Machine (UTM) and a Water Absorption Test conducted at home [17].

The next phase focuses on the analysis and interpretation of the experimental results [18].

This involves calculating the mean compressive strength and water absorption values for both types of blocks, computing the variance for each set of test results, and assessing the accuracy of the gathered data using the t-test [19-22]. The t-test was conducted using MATLAB to determine the statistical significance of the differences between EPS Blocks and CHBs. The final step is to interpret these results based on the t-test outcomes, concluding the comparative effectiveness of EPS Blocks and CHBs for building construction [23-26].

III. RESULTS AND ANALYSIS

The results from the compressive strength tests indicate that Expanded Polystyrene (EPS) blocks exhibit a significantly higher compressive strength compared to Concrete Hollow Blocks (CHBs). The mean compressive strength of EPS blocks is approximately 663.55 psi, whereas CHBs have a mean compressive strength of 398.88 psi. This substantial difference highlights the superior load-bearing capacity of EPS blocks in comparison to CHBs. The margin of error for EPS blocks is notably smaller (±0.06 psi) than that of CHBs (±17.40 psi), reflecting a higher precision in the EPS block measurements. The t-test results further support this difference, with a t-statistic of 28.66 and a p-value of 0.00000692, indicating that the difference in compressive strength between EPS blocks and CHBs is statistically significant.

On the other hand, the water absorption test results reveal that EPS blocks have a lower average water absorption rate (16.58%) compared to CHBs (24.20%). This suggests that EPS blocks are less porous and have better resistance to water penetration. The error margin for the water absorption test is smaller for EPS blocks (±0.33%) than for CHBs (±0.29%), indicating a more consistent measurement for both materials. The t-test results for the water absorption test show a t-statistic of -34.07 with a p-value of 0.00000445, reinforcing that the observed differences in water absorption rates between EPS blocks and CHBs are statistically significant.

Table 1. Comparative Matrix between EPS Blocks and CHBs

Criteria	Expanded Polystyrene (EPS)Blocks	Concrete Hollow Blocks (CHBs)	Analysis
Compressive Strength	Mean ± Margin of Error: 663.55 ± 0.06 psi	Mean ± Margin of Error: 398.88 ± 17.40 psi	EPS blocks exhibit a significantly higher compressive strength compared to CHBs. The t-test results (tStatistic: 28.66; p-Value: 0.00000692) show that this difference is statistically significant ($p<0.05$). This suggests that EPS blocks are substantially stronger under compression.
Water Absorption Test	Mean ± Margin of Error: 16.58 ± 0.33%	Mean ± Margin of Error: 24.20 ± 0.29%	EPS blocks have lower water absorption

			compared to CHBs. The t-test results (t-Statistic: -34.07; p-Value: 0.00000445) indicate that this difference is statistically significant ($p<0.05$).
Structural Performance	Higher load-bearing capacity due to higher compressive strength	Lower load-bearing capacity due to lower compressive strength	EPS blocks, with higher compressive strength, provide better structural support and are suitable for more demanding load-bearing applications.
Durability	Lower water absorption suggests better resistance to moisture	Higher water absorption indicates less resistance to moisture	Lower water absorption in EPS blocks implies better moisture resistance, enhancing their durability. Materials with lower water absorption are less prone to degradation, weakening, or damage from freeze-thaw cycles, making EPS blocks potentially more durable in moisture-prone environments.
Thermal Insulation	Potentially better thermal insulation due to lower water absorption	Potentially lower thermal insulation due to higher water absorption	Lower water absorption in EPS blocks may enhance their thermal insulation properties, contributing to better energy efficiency in buildings.
Material Longevity	Longer service life due to high strength and low water absorption	Shorter service life due to lower strength and higher water absorption	EPS blocks are likely to have a longer service life as they combine high compressive strength with low water absorption, reducing the risk of deterioration over time.
Maintenance Requirements	Likely to require less maintenance due to better durability	Likely to require more maintenance due to higher water absorption and lower strength	EPS blocks may offer cost savings over time with reduced maintenance needs, owing to their durability and lower water absorption.
Environmental Impact	Lower environmental impact due to longer life and less maintenance	Higher environmental impact due to shorter life and more maintenance	EPS blocks may be more environmentally friendly by reducing the need for replacements and repairs, which conserves resources.

IV. Conclusion

The experimental results demonstrate that EPS blocks possess a significantly higher compressive strength compared to CHBs, with mean values of 663.55 psi and 398.88 psi, respectively. This indicates that EPS blocks have a superior load-bearing capacity, making them more suitable for structural applications that require robust support. The statistical significance of this difference, with a t-Statistic of 28.66 and a p-Value of 0.00000692, underscores the reliability of these findings.

Additionally, the water absorption tests reveal that EPS blocks have a lower absorption rate (16.58%) compared to CHBs (24.20%). This lower absorption rate suggests that EPS blocks are more resistant to moisture, which is a critical factor for the longevity and durability of construction materials. The t-Statistic of 34.07 and a p-Value of 0.00000445 further validate the statistical significance of these results.

These findings align with those of other studies in the field. For instance, Ahmad et al. (2020) found that EPS blocks exhibit better compressive strength and lower water absorption compared to traditional concrete blocks, making them more suitable for load-bearing walls in construction. Similarly, research by Kumar and Singh (2019) highlighted the superior thermal insulation and moisture resistance properties of EPS blocks, supporting their use in climates with high humidity.

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