IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 7, July 2025

DOI: 10.17148/IARJSET.2025.12730

EXPANDED POLYSTYRENE POZZOLANA BLOCK

Reshma Biju[1], Avani B[2], Akshara Rajan[3], Aswin A J[4]

Assistant Professor, Civil Engineering Department, College of Engineering Kidangoor, Kottayam, Kerala[1]

B.Tech Scholar, Civil Engineering Department, College of Engineering Kidangoor, Kottayam, Kerala[2-4]

Abstract: This research explores the development of sustainable, lightweight, and thermally efficient building materials through the combination of Expanded Polystyrene (EPS) beads and Surkhi.EPS is well-known for its low density and excellent insulation properties, which help reduce the weight and energy consumption of construction materials. The EPS beads are coated with cement in a 1:1 ratio.Surkhi, a recycled byproduct obtained from crushed bricks or burnt clay, acts as a natural pozzolanic material that improves the compressive strength, durability, and water resistance of concrete. When combined, these materials offer a cost-effective and environmentally friendly alternative to traditional fine aggregates, supporting circular economy principles and reducing the ecological footprint of the construction industry.This composite approach aims to address growing concerns about the depletion of natural resources, material waste, and energy efficiency in modern construction. The study was conducted in two phases: first, Surkhi was used to partially replace fine aggregates at rates of 10%, 15%, 20%, and 25%; next, EPS beads were added at levels of 1%, 3%, 5%, and 7%. Various mix combinations were tested for compressive strength, density, and water absorption to determine the most effective formulation. Ultimately, the top-performing block was compared to a commercially available AAC (Autoclaved Aerated Concrete) block to evaluate its suitability in terms of structural performance, weight, insulation, and cost. The results highlight the potential of the EPS–Surkhi block as a sustainable choice in contemporary construction.

Keywords: Surkhi, Expanded Polystyrene (EPS), Expanded Polystyrene Pozzolana block (EPP), Autoclaved Aerated Concrete (AAC) block, Compressive strength, Block density, Water absorption.

I. INTRODUCTION

The rising need for innovative and sustainable construction materials stems from increasing environmental issues, resource scarcity, and the necessity to implement eco-friendly building methods. In the realm of concrete technology, significant strides are being taken to substitute traditional materials with environmentally friendly options. This research explores the application of Expanded Polystyrene (EPS) beads and Surkhi as partial replacements for fine aggregates in concrete and block production. EPS beads, sourced from expanded polystyrene foam, are lightweight, low-density plastic pellets commonly utilized in packaging. When added to concrete, they create lightweight mixtures, lowering overall density without greatly sacrificing strength, making them suitable for non-load-bearing structures. Furthermore, EPS improves thermal and acoustic insulation, fostering energy-efficient and comfortable living spaces. Nonetheless, their incorporation may influence compressive strength, necessitating precise mix design. Surkhi, a pozzolanic substance derived from burnt clay or brick, has been historically utilized in Indian architecture and enhances strength, durability, and water resistance through secondary hydration processes. Its addition improves workability, decreases shrinkage, and boosts long-term performance. Replacing natural sand with Surkhi alleviates environmental challenges such as riverbed depletion and promotes recycling by using waste materials. Additionally, the use of Surkhi helps lower carbon emissions by reducing cement consumption. In building blocks, Surkhi enhances compressive strength and chemical resistance, while providing economic benefits due to its local availability and affordability. This study intends to assess the compressive strength, durability, thermal and acoustic characteristics, and environmental effects of building blocks produced with EPS and Surkhi. The synergy of these materials presents a promising strategy for creating lightweight, durable, cost-effective, and sustainable alternatives to conventional concrete, especially in areas confronted with environmental and resource limitations.

II. LITERATURE REVIEW

Arif R. et al. (2021) investigated the partial substitution of cement with waste brick powder (WBP) in concrete. WBP was utilized at replacement levels of 5% and 10%. The findings indicated enhanced workability due to the spherical shape of the particles functioning as lubricants. A 10% substitution resulted in an 18% increase in compressive strength,

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⫶ Peer-reviewed & Refereed journal ⫶ Vol. 12, Issue 7, July 2025

DOI: 10.17148/IARJSET.2025.12730

a 17% rise in split tensile strength, and a 12% improvement in flexural strength. Nondestructive testing further validated the improved quality. The density experienced a slight reduction as WBP possesses a lower specific gravity compared to cement. The study concluded that WBP serves as a feasible eco-friendly alternative to cement, with the optimal replacement level identified as 10%.

Raini I. et al. (2020) investigated the application of recycled fine aggregates (RFA) derived from brick and concrete waste in mortar. Replacement levels ranging from 0% to 90% were examined. Substituting up to 15% RFA did not impact compressive or flexural strength. However, strength diminished at higher percentages due to increased porosity. Microstructural analysis revealed broader transition zones and a greater number of micro-fractures at elevated RFA levels. The porosity of recycled materials led to increased water absorption, compromising the mortar's integrity. Despite these challenges, a substitution level of 30% to 45% was considered acceptable with minimal strength loss. The study promotes the utilization of recycled waste in sustainable construction.

Babu G. et al. (2003) assessed the use of fly ash concrete incorporating EPS as a lightweight aggregate. EPS substituted conventional aggregates, resulting in concrete densities ranging from 550 to 2200 kg/m³ and strengths varying from 1.5 to 24 MPa. The inclusion of EPS led to a reduction in absorption and chloride permeability by 50 to 65%. By replacing 50% of the cement with fly ash, durability was improved. The mixture demonstrated resistance to chemical attacks and exhibited acceptable levels of water penetration. Evaluations included assessments of permeability, absorption, and acid resistance. The research validated the feasibility of EPS concrete for lightweight and durable applications, providing both performance and sustainability advantages.

Rahul S. et al. (2020) explored the utilization of brick waste as fine aggregate in the production of paver blocks. Replacement levels of 25%, 50%, and 75% were tested, with varying amounts of fines content. Compressive strength was sustained up to a 50% replacement level. However, at 75%, performance declined unless the fines content was restricted to 10%. Water absorption increased with higher levels of waste content, surpassing Indian standards. Flexural strength remained adequate across all mixtures. The variation in density among the paver blocks was minimal. This research advocates for the reuse of brick waste in the manufacturing of paver blocks, promoting sustainable practices.

Allahverdi A. et al. (2018) created a green lightweight reactive concrete by incorporating EPS and GGBFS. The use of EPS ranged from 0% to 45% volumetric replacement, which led to a reduction in concrete density to as low as 1257 kg/m³. The compressive strengths achieved were as high as 85.6 MPa. Curing temperatures between 100°C and 200°C had an impact on both strength and water absorption. The water absorption rate decreased from 3.47% to 0.22% with an increase in EPS content. Although challenges such as segregation and poor bonding were encountered, these issues were addressed through effective mix design. This mix was recommended for use in earthquake-resistant structures due to its low weight and favorable strength characteristics. The research highlights GLRPC as a durable, lightweight, and environmentally friendly concrete solution.

Rosca B. et al. (2020) investigated the incorporation of EPS beads in structural-grade concrete with varying aggregate distributions. EPS was added at levels of 15%, 25%, and 35% by volume. An increase in EPS content resulted in a decrease in compressive strength; however, the mix remained within the structural-grade limits up to 25%. The study noted that uniform dispersion of EPS prevented segregation. Additionally, EPS enhanced thermal insulation and contributed to a reduction in concrete weight. The water absorption remained low due to the non-absorbent properties of EPS. Variations in aggregate distributions affected the strength outcomes. The findings indicate that EPS concrete is a feasible option for lighter, energy-efficient buildings.

Rosca B. (2021) conducted a comparison of lightweight concrete utilizing recycled brick aggregates alongside EPS beads. The research evaluated EPS at replacement levels of 15%, 25%, and 35%. At the 25% replacement level, the concrete achieved a structural-grade compressive strength ranging from 20 to 30 MPa. However, at 35%, the strength slightly fell below the minimum requirements. A density reduction of up to 27% was recorded. The concrete was found to be appropriate for non-load-bearing applications and sustainable design practices. Modifying the water-cement ratio led to improved performance. EPS-RBA concrete presents a sustainable alternative to conventional natural aggregates.

Ahmad J. (2017) examined the impact of Surkhi as a partial substitute for fine aggregate in concrete bricks. A replacement of up to 15% Surkhi resulted in increased compressive strength and reduced water absorption. Efflorescence and shrinkage were also minimized. However, strength diminished at higher replacement levels due to excessive bleeding. The tests conducted included assessments of soundness, hardness, and efflorescence. Surkhi was found to be cost-effective and improved the quality of bricks. As a waste material, it contributed to sustainability. The study concludes that Surkhi bricks represent a cost-effective, high-performance alternative to traditional bricks.

DOI: 10.17148/IARJSET.2025.12730

III. OBJECTIVES / AIMS

- TO ASSESS THE MECHANICAL PROPERTIES OF A BUILDING BLOCK THAT INCLUDES EPS BEADS AND SURKHI.
- TO IDENTIFY THE OPTIMAL CONTENT OF SURKHI AND EPS BEADS.
- TO EXAMINE THE VARIATIONS IN COMPRESSIVE STRENGTH OF THE BLOCK WITH VARYING PERCENTAGES OF SURKHI AND EPS BEADS.
- TO COMPARE THE FEATURES OF THE EPP BLOCK WITH THOSE OF THE AAC BLOCK.

IV. METHODOLOGY

Literature review
Collection of materials
Test on basic properties of materials
Estimation of materials
Preparation of specimen
Testing of specimen
Performance evaluation of EPP block
Testing AAC block
Comparing EPP and AAC block
Result and discussion

V. MATERIALS USED

Cement

Cement serves as the binding agent in concrete, uniting all components. This study utilizes Portland Pozzolana Cement (PPC), provided by Ultratech. It is grey in hue and adheres to IS 1489 (Part 1): 1991 standards. PPC is favored for its durability, enhanced resistance to chemical attacks, and its appropriateness for long-term construction.

Fine Aggregate

Fine aggregate consists of materials that predominantly pass through a 4.75 mm sieve. For this project, Manufactured Sand (M-Sand) is employed, created by crushing granite stones. M-Sand is angular, devoid of clay and organic matter, and complies with IS 383:2016 standards. It provides superior strength and consistency compared to natural sand.

Surkhi

Surkhi is a pozzolanic substance derived from crushed burnt bricks or clay. It enhances workability and durability while minimizing bleeding and segregation in concrete. Although it may slightly diminish early strength, it improves long-term performance. In this research, Surkhi is utilized as a partial substitute for fine aggregate in powdered form.

Expanded Polystyrene (EPS) Beads

EPS beads are lightweight, non-biodegradable particles made from polystyrene foam. They offer excellent thermal and sound insulation. Incorporating EPS into concrete reduces the weight of blocks, boosts energy efficiency, and improves comfort. Their application promotes sustainable and cost-effective construction. EPS beads are coated with cement in a 1:1 ratio.

Water

Water is crucial for the hydration of cement in concrete. The water used is clean, free from contaminants, and maintains a pH level between 6 and 8 to ensure adequate setting and strength development.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⯊ Peer-reviewed & Refereed journal ⯊ Vol. 12, Issue 7, July 2025

DOI: 10.17148/IARJSET.2025.12730

VI. TEST ON MATERIALS

The Following tests were conducted to determine the physical properties of :

Cement

- ***Specific gravity test (IS 4031: 1988)*** : The test is conducted to verify the quality and density of the cement.
- ***Standard consistency test (IS 4031(part IV):1988)*** : The test is conducted to ascertain the exact quantity of water required to produce a cement paste with a standard, workable consistency.
- ***Initial setting time (IS 4031(part V):1988)*** : The test reveals the duration permitted for mixing, transporting, and placing concrete before it begins to set and lose its workability.

Fine aggregate

- ***Specific gravity test (IS 383: 1970)*** : The purpose of the test is to assess its density in comparison to water.
- ***Sieve Analysis (IS 2386: 2021)*** : The test is conducted to ascertain the distribution of particle sizes.

Surkhi

- ***Specific gravity test (IS 383: 1970)*** : The assessment is conducted to evaluate its quality and appropriateness for application in construction.
- ***Sieve Analysis (IS 2386: 2021)*** : The test is conducted to ascertain the distribution of particle sizes.

VII. TEST ON SPECIMEN

- ***Hardness***: The test is conducted to evaluate its resistance to indentation and deformation.
- ***Soundness***: The assessment is conducted to determine its ability to withstand expansion or contraction resulting from variations in temperature or humidity.
- ***Structure test***: The test is conducted to evaluate its capacity to endure designated loads and stresses.
- ***Compression test (IS 516 (Part 1 sec I) - 2021)***: The test is conducted to evaluate its capacity to endure compressive forces.
- ***Water absorption test (IS 2185(Part 1) - 2005)***: The assessment is conducted to evaluate its durability and moisture resistance.
- ***Efflorescence***: The test is conducted to assess the natural evaporation of moisture and salts present in the material.
- ***Block density (IS 2185(Part 1) - 2005)***: The test is conducted to ascertain its mass per unit volume, which aids in evaluating its strength and appropriateness for construction.






DOI: 10.17148/IARJSET.2025.12730

VIII. RESULTS & DISCUSSION

Material test results

Table 8.1 Cement test results

Sl. No	Properties tested	Test results	Specification
1	Specific gravity test	2.9	2.5-3.0
2	Standard consistency test	31	26%-33%
3	Initial setting time	150 minutes	Not less than 30 minutes

Table 8.2 Fine aggregate test results

Sl. No	Properties tested	Test results	Specification
1	Specific gravity test	2.5	2.3-2.9
2	Fineness modulus	3.81	2-4

Table 8.3 Surkhi test results

Sl. No	Properties tested	Test results	Specification
1	Specific gravity test	2.5	2.3-2.9
2	Fineness modulus	3.71	2-4

Table 8.4 Sieve analysis result of fine aggregate

Sieve Size	Weight retained (g)	Percentage Weight retained (g)	Cumulative Percentage Weight retained (g)	Percentage Weight passing (g)
4.75mm	0	0	0	100
2.36mm	79	7.9	7.9	92.1
1.18mm	242	24.2	32.1	67.9
0.6mm	256	25.6	57.7	42.3
0.3mm	278	27.8	85.5	14.5
0.15mm	121	12.1	97.6	2.4
Pan	24	2.4	100	0

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 7, July 2025
DOI: 10.17148/IARJSET.2025.12730

Table 8.4 Sieve analysis result of surkhi aggregate

Sieve Size	Weight retained (g)	Percentage Weight retained (g)	Cumulative Percentage Weight retained (g)	Percentage Weight passing (g)
4.75mm	0	0	0	100
2.36mm	83	8.3	8.3	91.7
1.18mm	246	24.6	32.9	67.1
0.6mm	260	26	58.9	41.1
0.3mm	276	27.6	86.5	13.5
0.15mm	115	11.5	98	2
Pan	20	2	100	0

Specimens test results

Table 8.5 Hardness test result

Specimen name	Result of hardness
BS0	No impression after scratching
BS10	No impression after scratching
BS15	No impression after scratching
BS20	No impression after scratching
BS25	No impression after scratching
BS20E1	No impression after scratching
BS20E3	No impression after scratching
BS20E5	No impression after scratching
BS20E7	Mild impression after scratching

Table 8.6 Soundness test result

Specimen name	Result of soundness
BS0	Ringing sound is produced and brick is not broken
BS10	Ringing sound is produced and brick is not broken
BS15	Ringing sound is produced and brick is not broken
BS20	Ringing sound is produced and brick is not broken
BS25	Ringing sound is produced and brick is not broken
BS20E1	Ringing sound is produced and brick is not broken
BS20E3	Ringing sound is produced and brick is not broken
BS20E5	Ringing sound is produced and brick is not broken
BS20E7	Ringing sound is produced and brick is not broken

Table 8.7 Structure test result

Specimen name	Result of structure
BS0	It was discovered that the brick were uniform, no lumps had formed, and voids were observed.
BS10	It was discovered that the brick were uniform, no lumps had formed, and voids were observed.
BS15	It was discovered that the brick were uniform, no lumps had formed, and voids were observed.
BS20	It was discovered that the brick were uniform, no lumps had formed, and voids were observed.
BS25	It was discovered that the brick were uniform, no lumps had formed, and voids were observed.
BS20E1	It was discovered that the brick were uniform, no lumps had formed, and voids were observed.
BS20E3	It was discovered that the brick were uniform, no lumps had formed, and voids were observed.
BS20E5	It was discovered that the brick were uniform, no lumps had formed, and voids were observed.
BS20E7	It was discovered that the brick were uniform, no lumps had formed, and voids were observed.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.311 ⁙ Peer-reviewed & Refereed journal ⁙ Vol. 12, Issue 7, July 2025
DOI: 10.17148/IARJSET.2025.12730

Table 8.8 Compressive strength test result

Specimen	Days	SL.No	Load (kN)	Compressive Strength (MPa)	Average Compressive Strength (MPa)
BS0	7	1	76	7.6	7.6
		2	78	7.8	
		3	76	7.6	
	14	1	80	8.2	8.2
		2	84	8.4	
		3	80	8	
	28	1	320	32	32.73
		2	340	34	
		3	322	32.2	
BS10	7	1	58	5.8	5.8
		2	58	5.8	
		3	58	5.8	
	14	1	64	6.4	6.33
		2	62	6.2	
		3	64	6.4	
	28	1	296	29.6	29.72
		2	298	29.8	
		3	298	29.8	
BS15	7	1	22	2.2	2.13
		2	20	2.0	
		3	22	2.2	
	14	1	32	3.2	3.2
		2	34	3.4	
		3	30	3	
	28	1	302	30.2	30.2
		2	300	30	
		3	304	30.4	
BS20	7	1	60	6	6.1
		2	62	6.2	
		3	60	6.0	
	14	1	72	7.2	7.2
		2	70	7.0	
		3	74	7.4	
	28	1	314	31.4	31.4
		2	312	31.2	
		3	316	31.6	
BS25	7	1	50	5.0	5.07
		2	52	5.2	
		3	50	5	
	14	1	62	6.2	6.3
		2	64	6.4	
		3	64	6.4	
	28	1	300	30	30.4
		2	308	30.8	
		3	304	30.4	
BS20E1	7	1	56	5.6	5.53
		2	56	5.6	
		3	54	5.4	
	14	1	162	16.2	16.33
		2	164	16.4	
		3	164	16.4	
		1	300	30	

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 7, July 2025
DOI: 10.17148/IARJSET.2025.12730

	28	2	320	32	31.33
		3	320	32	
BS20E3	7	1	64	6.4	6.27
		2	62	6.2	
		3	62	6.2	
	14	1	172	17.2	17.33
		2	174	17.4	
		3	174	17.4	
	28	1	320	32	31.8
		2	318	31.8	
		3	316	31.6	
BS20E5	7	1	52	5.2	5.28
		2	54	5.4	
		3	52	5.2	
	14	1	152	15.2	15.28
		2	154	15.4	
		3	152	15.2	
	28	1	292	29.2	29.33
		2	296	29.6	
		3	294	29.4	
BS20E7	7	1	52	5.2	5.2
		2	54	5.4	
		3	50	5	
	14	1	146	14.6	14.46
		2	144	14.4	
		3	144	14.4	
	28	1	286	28.6	28.46
		2	284	28.4	
		3	284	28.4	

Table 8.9 Water Absorption test result

Specimen	**Average % result of water absorption**
BS0	6.8
BS10	16.6
BS15	14.66
BS20	12.44
BS25	17.3
BS20EI	8.4
BS20E3	6.9
BS20E5	16.16
BS20E7	16.99

Table 8.10 Efflorescence test result

Specimen name	**Efflorescence**
BS0	No efflorescence found
BS10	No efflorescence found
BS15	No efflorescence found
BS20	No efflorescence found
BS25	No efflorescence found
BS20EI	No efflorescence found
BS20E3	No efflorescence found
BS20E5	No efflorescence found
BS20E7	No efflorescence found

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁙ Peer-reviewed & Refereed journal ⁙ Vol. 12, Issue 7, July 2025

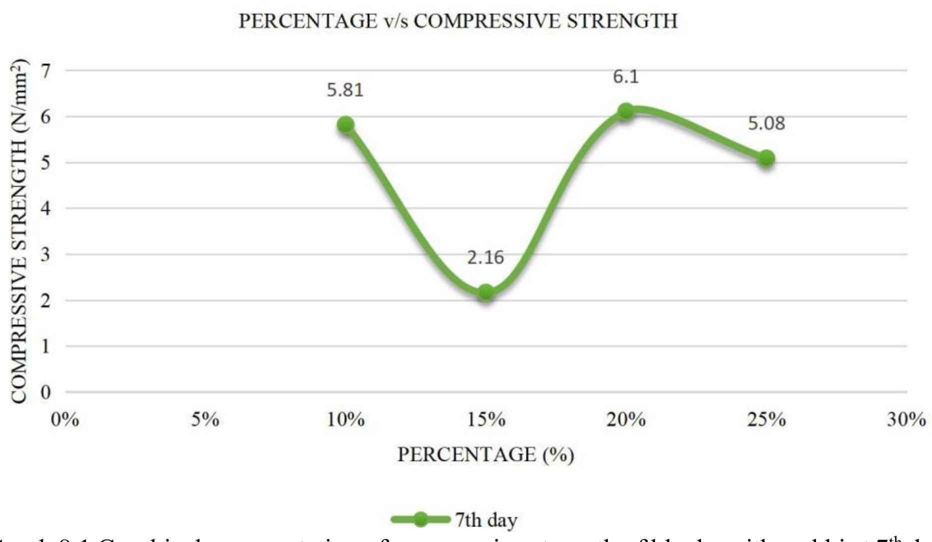
DOI: 10.17148/IARJSET.2025.12730

Table 8.11 Block density test result

Specimen	Block density in (kg/m^3)
BS0	2240
BS10	1754.7
BS15	1426.7
BS20	1656.7
BS25	1520
BS20E1	1000
BS20E3	980
BS20E5	880
BS20E7	830

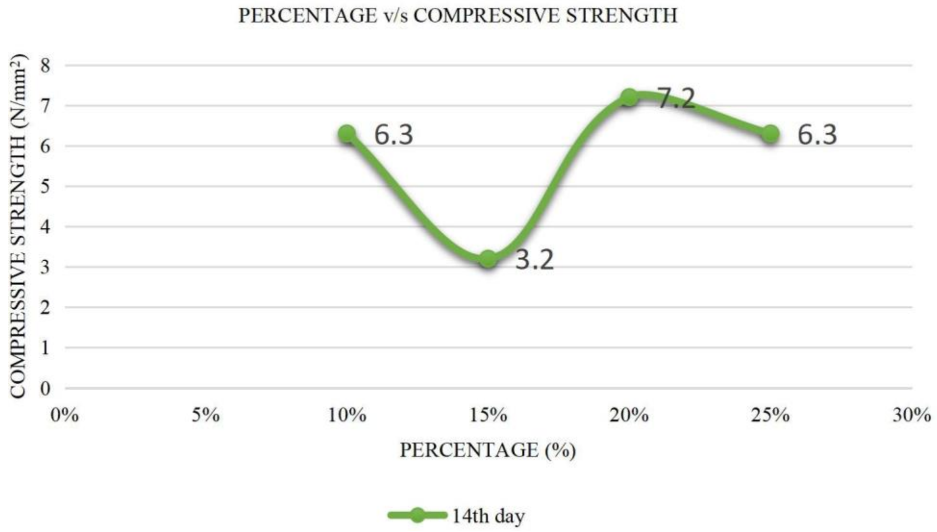
Table 8.12 Comparison result b/w AAC, EPP & Conventional (BS0) blocks

Properties	AAC block	EPP block	Conventional block
COMPRESSIVE STRENGTH	28 N/mm^2	31.8 N/mm^2	32.73 N/mm^2
WATER ABSORPTION	8%	6.9 %	6.8%
WEIGHT	0.600 kg	0.980 kg	2.240 kg
DENSITY	600 kg/m^3	980 kg/m^3	2240 kg/m^3



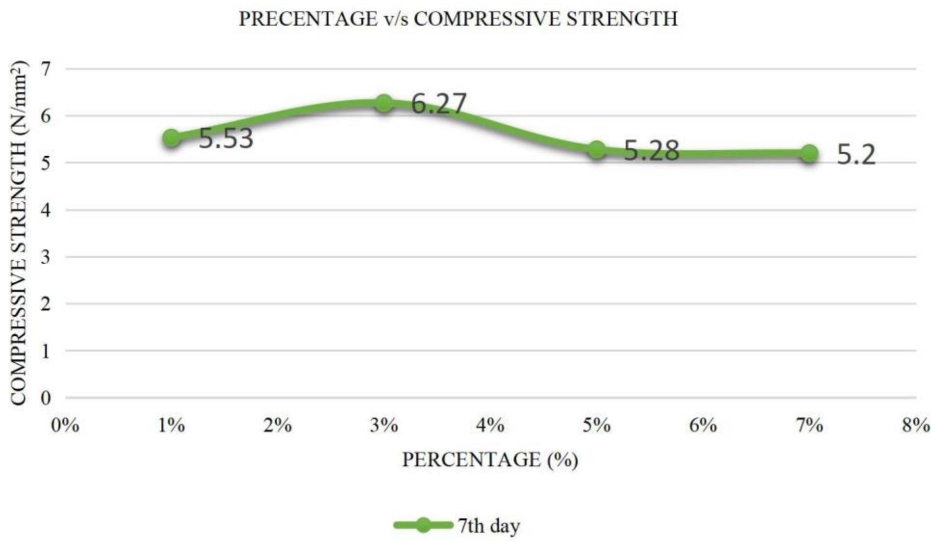
Graph 8.1 Graphical representation of compressive strength of blocks with surkhi at 7th day

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 7, July 2025
DOI: 10.17148/IARJSET.2025.12730



Graph 8.2 Graphical representation of compressive strength of blocks with surkhi at 14th day

Graph 8.3 Graphical representation of compressive strength of blocks with surkhi at 28th day



Graph 8.4 Graphical representation of compressive strength of blocks with surkhi and EPS beards at 7th day

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

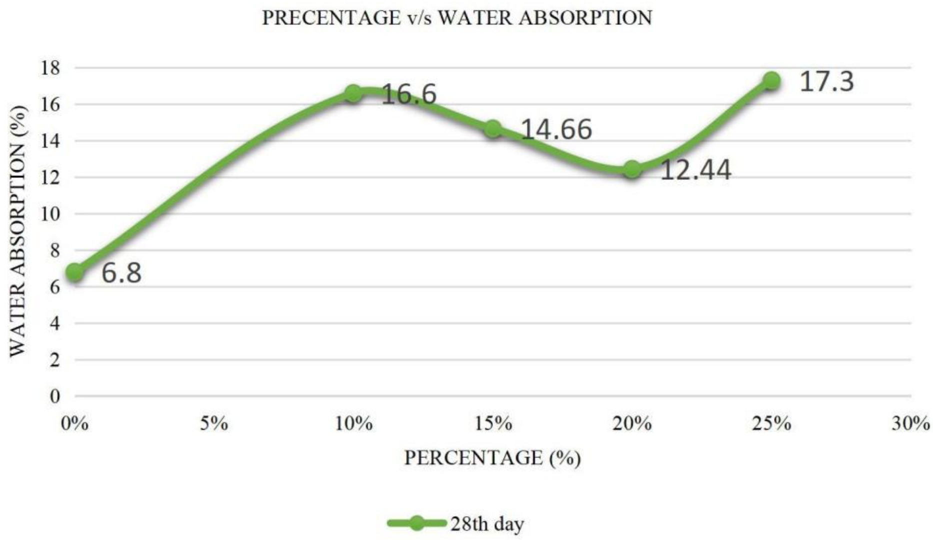
International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 7, July 2025

DOI: 10.17148/IARJSET.2025.12730

Graph 8.4 Graphical representation of compressive strength of blocks with surkhi and EPS beards at 14th day

Graph 8.4 Graphical representation of compressive strength of blocks with surkhi and EPS beards at 28th day



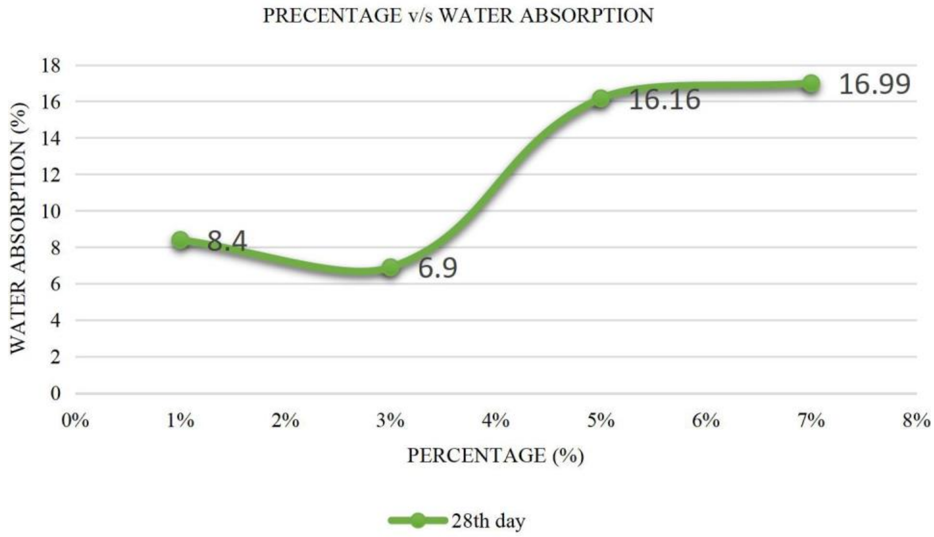
Graph 8.5 Graphical representation of water absorption of blocks with surkhi at 28th day

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 7, July 2025

DOI: 10.17148/IARJSET.2025.12730



Graph 8.6 Graphical representation of water absorption of blocks with surkhi and EPS beards at 28th day

IX. CONCLUSION

The following findings were derived from the aforementioned tests: -

° **Enhancing Mechanical Strength with Surkhi Substitution**: The partial substitution of fine aggregate with surkhi at levels of 10%, 15%, 20%, and 25% led to improved mechanical properties in the concrete blocks. The block with 20% surkhi reached about 90.3% of the compressive strength of the standard control block (32.78 kN). This strength variation is due to the increased levels of reactive silica and alumina present in surkhi, which promote additional pozzolanic reactions and densification of the matrix.
° **Incorporation of Expanded Polystyrene (EPS) Beads for Lightweight Properties**: EPS beads were added at rates of 1%, 3%, 5%, and 7% to improve the lightweight properties of the blocks. The block containing 20% surkhi and 3% EPS achieved 97.1% of the compressive strength of the conventional control block, showing a 5.3% enhancement compared to the block with only 20% surkhi, indicating synergistic effects at this level.
° **Optimal EPS Content**: A 3% addition of EPS was determined to be optimal, as higher amounts resulted in increased porosity, adversely affecting the interfacial transition zone (ITZ) and overall cohesion within the cementitious matrix, which could lead to brittle failure under load.
° **Bonding Characteristics**: Due to their non-porous and hydrophobic properties, EPS particles may weaken the bond between the cement paste and aggregate, potentially diminishing the composite action of the concrete and compromising structural integrity if not managed properly.
° **Efflorescence Resistance**: The blocks showed no visible salt deposits during efflorescence testing, demonstrating good resistance to salt migration and crystallization, thus making them suitable alternatives to traditional masonry units in terms of durability.
° **Surface Hardness**: The blocks exhibited a high level of surface hardness, with the majority of samples showing no visible surface impressions when scratched, confirming their resistance to abrasion and their suitability for construction purposes.
° **Soundness and Structural Performance**: The blocks demonstrated remarkable soundness and satisfactory results in structural loading assessments, suggesting their suitability for non-load bearing and light structural uses.
° **Block Density and Lightweight Nature**: The block containing 20% surkhi (BS20) displayed a density of 1656.7 kg/m³.
° In contrast, the block with 20% surkhi and 3% EPS (BS20E3) had a notably lower density of 980 kg/m³, categorizing it as a lightweight concrete block, ideal for scenarios where reducing dead load is advantageous.
° Partition walls in both residential and commercial structures due to their lighter weight, ease of installation, and cost-effectiveness.
° Non-structural infill between load-bearing components like beams and columns, enhancing seismic performance by minimizing mass.
° Boundary walls in residential areas, where a balance of aesthetic appeal and moderate strength is required.
° Architectural and landscaping elements, such as arches, decorative columns, and retaining walls, where lightweight properties, formability, and moderate structural strength are advantageous.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 7, July 2025

DOI: 10.17148/IARJSET.2025.12730

X. RECOMMENDATIONS

The experimental results suggest that adding 20% surkhi and 3% EPS beads to concrete mixtures creates a material that effectively balances mechanical strength, durability, and reduced weight.This particular blend exhibited improved performance traits ideal for lightweight, non-load-bearing uses, including partition walls, boundary structures, and architectural features.The addition of surkhi enhances pozzolanic activity, while EPS beads lower overall density without significantly affecting structural integrity.Nonetheless, the long-term performance of these blocks in various environmental conditions is still uncertain.Moreover, essential functional properties like thermal and acoustic insulation need further assessment.The interaction of this mixture with reinforcement and surface finishes (such as plaster or mortar) also requires examination to ensure compatibility in construction.Finally, a comprehensive cost–benefit and scalability analysis is crucial to assess the economic feasibility of using this composite mix in commercial construction.

REFERENCES

[1]. Rehan Arif, Anwar Khitab, Mehmet Serkan Kırgız, Raja Bilal Nasar Khan Seemab Tayyab, Riaz AkhtarKhan, Waqas Anwar, Muhammad Tausif Arshad. . "The Experimental analysis on partial replacement of cement with brick powder in concrete" Case studies in Construction Materials 15 (2021) e00749

[2]. Shaila Sharmin, Prabir K. Sarker, Wahidul K. Biswas, Rajab M. Abousnina, Usman Javed**.** "Characterization of Waste Clay Brick and its Effect on the Mechanical Properties and Microstructure of Geopolymer Mortar"Construction and Building Materials volume 412 (2024) 134848

[3]. Imane Rainia, Raouf Jabranea, Laila Mesrarb, Mariam Akdima. "Evaluation of mortar properties by combining concrete and brick wastes as fine aggregate" Case Studies in Construction Materials volume 13 (2020) e00434

[4]. K. Ganesh Babu, D. Saradhi Babu. "Performance of fly ash concretes containing lightweight EPS aggregate"Cement and Concrete Composites volume 26 issue 6 (2003) :605-611

[5]. Daigoro Isobe, Tomohiro Shibuya. "Preliminary numerical study on the reduction of seismic pounding damage to buildings with expanded polystyrene blocks" Engineering Structures volume 252 (2022) 113723

[6]. Sai Rahul D, Sai Vikas Reddy, Tarun N, S.M. Basutkar, Ravikiran S. Wali, M.V. Renukadevi**.** "Influence of brick waste and brick waste fines as fine aggregate on the properties of paver blocks – Preliminary investigation"Materials Today: Proceedings volume 43 part 2 (2021) :1496-1502

[7]. Ali Allahverdi, Seyed Amin Azimi, Mehdi Alibabaie. "Development of multi-strength grade green lightweight reactive Concrete using expanded polystyrene beads" Construction and Building Materials volume 172 (2018) :457-467

[8]. Bogdan Rosca, Vladimir Corobceanu."Structural grade concrete containing expanded polystyrene beads with different particle distributions of normal weight aggregate" Materials Today: Proceedings volume 42 part 2 (2021) :548-554

[9]. Bogdan Rosca "Comparative aspects regarding a novel lightweight concrete of structural grade containing brick aggregate as coarse particles and expanded polystyrene beads"Materials Today: Proceedings volume 45 part 6 (2021) :4979-4986

[10]. B.M. Vinay Kumar, H. Ananthan, K.V.A. Balaji**.**"Experimental studies on cement stabilized masonry blocks prepared from brick, fine recycled concrete aggregate and pozzolanic materials" Journal of Building Engineering volume 10 (2017) :80-88

[11]. Soni Kumari."Development of light weight Geoblocks for wall building units using eps beads and fly ash"IJERT volume 6 issue 4 (2017) :2278-0181

[12]. Jan wakeel Ahmad Wani."Influence of Surkhi on Various Properties of Concrete Bricks"IJERT volume 6 issue 4 (2017) :2278-0181