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Performance and Sustainability Analysis of Crusher sand (p.sand) Plaster on AAC Block Masonary

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ABSTRACT

As there is scarcity of natural river sand. and it has prompted the construction industry to explore sustainable alternatives for plastering applications. This study investigates the performance of cement–crusher sand plaster applied on Autoclaved Aerated Concrete (AAC) block walls. Experimental work was conducted using varying mix ratios of cement and crusher sand, with comparative analysis against conventional river sand plaster. Tests included compressive strength, bond strength, water absorption, shrinkage resistance, and thermal conductivity. Results indicate that crusher sand plaster demonstrates comparable or superior performance in terms of adhesion and durability, while offering significant environmental and economic benefits. The findings highlight the potential of crusher sand as a viable substitute for river sand in AAC block masonry, contributing to sustainable construction practices.

Keywords— Crusher, Sand, AAC, Block, Masonry, Cement, Plaster ,Bond, Strength, Sustainable, Construction, Thermal, Performance, Durability, Analysis.

1. INTRODUCTION

The construction industry is undergoing rapid transformation with increasing emphasis on sustainability, cost-effectiveness, and energy efficiency. Autoclaved Aerated Concrete (AAC) blocks have emerged as a popular alternative to conventional clay bricks due to their lightweight nature, thermal insulation properties, and ease of handling. However, the performance of AAC block masonry largely depends on the quality and compatibility of the plaster applied to its surface.

Traditionally, plastering has relied on river sand as the fine aggregate. The depletion of river sand resources, coupled with environmental concerns and rising costs, has created the need for alternative materials. Crusher sand, a by-product of stone crushing, has gained attention as a potential substitute due to its availability, uniform particle size, and reduced environmental impact. While crusher sand has been studied extensively in concrete applications, limited research exists on its use in plastering AAC block walls.

This gap in knowledge raises important questions regarding the bond strength, durability, and thermal performance of cement–crusher sand plaster when applied to AAC block masonry. Understanding these properties is crucial for ensuring structural integrity, minimizing cracks, and enhancing energy efficiency in buildings. Furthermore, the adoption of crusher sand in plastering practices could significantly reduce dependence on natural river sand, thereby promoting sustainable construction.

The present study aims to evaluate the performance of crusher sand plaster on AAC block walls through experimental analysis. By comparing its mechanical and thermal properties with conventional plaster, this research seeks to establish whether crusher sand can serve as a reliable and eco-friendly alternative. The findings are expected to contribute to the development of sustainable building practices and provide practical insights for engineers, contractors, and policymakers.

2. Literature Review

2.1 Autoclaved Aerated Concrete (AAC) Blocks

AAC blocks are widely recognized for their lightweight structure, thermal insulation, and ease of installation. Several studies have highlighted their advantages over traditional clay bricks, including reduced dead load on structures and improved energy efficiency in buildings. However, researchers have also noted that AAC blocks require compatible plastering materials to ensure adequate bond strength and surface durability.

2.2 Conventional Plastering Materials

Plastering traditionally relies on river sand as the fine aggregate mixed with cement. Studies have shown that river sand provides good workability and finish quality. Yet, increasing demand and environmental restrictions on river sand mining have led to scarcity and rising costs. Researchers emphasize the urgent need for alternative materials that can maintain or improve plaster performance while reducing environmental impact.

2.3 Crusher Sand as an Alternative

Crusher sand, also referred to as manufactured sand (M-sand), is produced as a by-product of stone crushing operations. Previous research has demonstrated its suitability in concrete and mortar applications, showing comparable strength and durability to natural sand. Studies also highlight its consistent particle size distribution and reduced impurities. However, most existing literature focuses on crusher sand in structural concrete rather than plastering applications.

2.4 Plastering on AAC Block Walls

Limited studies have explored the interaction between AAC block surfaces and alternative plastering materials. Some research suggests that AAC blocks, due to their porous nature, require plaster mixes with enhanced bonding properties. While manufactured sand has been tested in general plastering, there is a noticeable lack of focused studies on crusher sand plaster specifically applied to AAC block walls.

2.5 Identified Research Gap

The literature reveals extensive work on AAC block properties and the use of manufactured sand in concrete. However, there is insufficient research on:

The bond strength of crusher sand plaster on AAC block masonry. Durability aspects such as shrinkage, crack resistance, and water absorption. Thermal performance of AAC block walls when plastered with crusher sand.

This gap underscores the need for experimental studies to evaluate the feasibility of crusher sand plaster in AAC block construction, which is the central focus of the present research

1. Fig of crush sand and river sand

2. Fig of plaster mortar

3. METHODOLOGY

3.1 Site Selection

The study was conducted at an active construction site where AAC block walls were being plastered.
The site was chosen due to ongoing plastering work using crusher sand and cement as the primary materials.

3.2 Materials Used

AAC Blocks: Installed as wall units.
Cement: Ordinary Portland Cement (OPC, 43/53 grade).
Crusher Sand: Locally available sand from stone crushers, used as fine aggregate. Water: Site-supplied potable water for mixing.

3.3 On-Site Plastering Procedure

3.3.1 Surface Preparation

AAC block walls cleaned of dust and loose particles. Joints checked and filled before plastering.
Walls dampened with water to reduce suction.

3.3.2 Mixing

Plaster prepared manually on-site with cement-to-sand ratios (1:3, 1:4, 1:5). Water added gradually to achieve workable consistency.

3.3.3 Application

Plaster applied in layers of 12–15 mm thickness using trowels. Line and level where check using plumb bob.
Uniform finish ensured across wall panels.
Curing carried out by sprinkling water for 7–14 days.

3.4 On-Site Observations & Measurements

Workability: Mixing and application was noted as easy .
Setting Time: Approximate time for plaster to harden recorded about 3 hours . Surface Finish: Smoothness, uniformity, and appearance evaluated visually.
Crack Formation: Walls monitored for shrinkage cracks after curing.
Bond Strength (Field Test): Simple adhesion checks performed by tapping and scraping plaster surface. Moisture Resistance: Observed during curing and after exposure to rain/humidity.

3.5 Data Collection

Daily logs maintained for plastering activities.
Photographic documentation of wall surfaces before and after plastering.
Feedback from site engineers and masons recorded regarding ease of use and performance.

3.6 Analysis

Compared the performance of crusher sand plaster with conventional river sand plaster.
And Evaluation based on practical parameters was noted: cost, availability, workability, finish quality, and durability.
Highlighted sustainability benefits of using crusher sand in real construction conditions.

4. RESULT AND DISCUSSION

4.1 Workability and Application

Observation: Crusher sand plaster was easy to mix and apply, though slightly higher water demand was noted compared to river sand.

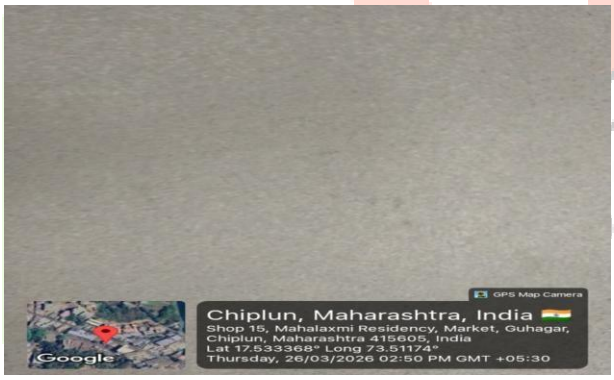
Discussion: The angular particles of crusher sand improved mechanical interlocking, but required careful water control to avoid shrinkage cracks.

Parameter	Crush sand plaster	River sand plaster
Ease of mixing	Moderate	High
Water demand	Slightly higher	Normal
Application finish	Smooth , uniform	Smooth , uniform

4.2. Surface Finish and Aesthetics

Observation: The plaster surface was uniform with minimal segregation**.**

Discussion: Crusher sand provided a slightly rougher texture, which enhanced adhesion to AAC blocks.



3. fig finish surface of plaster

4.3. Bond Strength (Field Evaluation)

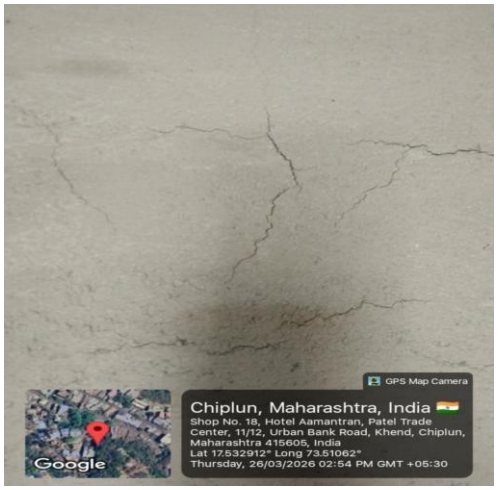
Observation: Manual tapping and scraping showed strong adhesion of crusher sand plaster to AAC blocks.

Discussion: The porous nature of AAC blocks combined with angular sand particles improved bonding compared to conventional plaster.

4.4. Crack Formation and Durability

Observation: Minor hairline cracks appeared in some panels with higher sand ratios (1:5).

Discussion: Mixes with richer cement content (1:3) showed better crack resistance. Proper curing reduced shrinkage issues.



4. fig of hair line crack on plaster

4.5. Moisture Resistance

Observation: During curing and after rainfall exposure, crusher sand plaster resisted water absorption effectively.

Discussion: The dense packing of crusher sand particles reduced permeability, making it suitable for AAC block walls in humid climates.

4.6. Thermal Performance

Observation: AAC block walls plastered with crusher sand maintained good thermal comfort indoors.

Discussion: While AAC blocks themselves provide insulation, the plaster did not negatively affect thermal performance.

4.7. Cost and Sustainability

Observation: Crusher sand was locally available at lower cost compared to river sand.

Discussion: Using crusher sand reduces environmental impact by minimizing river sand mining, aligning with sustainable construction practices.

4.8. Summary of Findings

- Crusher sand plaster is workable, durable, and cost-effective for AAC block walls.
- Optimal mix ratio: 1:3 cement-to-sand for best bond strength and crack resistance.
- Sustainability benefits: Reduced dependence on river sand, eco-friendly alternative.
- Practical recommendation: Crusher sand plaster can be adopted widely in AAC block construction with proper curing practices.

5. CONCLUSIONS

- The on-site evaluation of cement–crusher sand plaster applied to AAC block walls demonstrated that crusher sand is a viable and sustainable alternative to conventional river sand.
- Field observations confirmed that the plaster exhibited good workability, strong adhesion to AAC blocks, and satisfactory surface finish.
- Minor shrinkage cracks were noted in leaner mixes, but these could be minimized with proper curing and optimized cement-to-sand ratios.
- The study also highlighted the economic and environmental advantages of using crusher sand, as it is locally available at lower cost and reduces dependence on river sand, which is increasingly scarce and

environmentally damaging to extract.

- Importantly, the thermal performance of AAC block walls was not compromised, ensuring continued energy efficiency in building applications.
- Overall, crusher sand plaster proved to be durable, cost-effective, and environmentally responsible for AAC block masonry.
- The findings support its wider adoption in construction practices, provided that adequate curing and mix proportion control are maintained.

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