A Review on Economical Pre-cast Wall Panels Using Partial Replacement of Sand

Harsh D Sonak “, Zakia I Malik”, Gaurav K Sawaarbandhe “, Mayuri N Nannewar

Prof. Atika A Ingole’, Prof. Tejaswini S Junghare

Department of Civil Engineering, J D College of Engineering and Management,

Nagpur, Maharashtra, India

ABSTRACT

The escalating costs associated with precast construction, particularly within the housing sector, have become a major obstacle to affordability and accessibility. As a result, the construction industry is in need of innovative solutions to curb these cost increases and regain competitiveness. This project focuses on the implementation of sawdust as a potential substitute for sand in precast concrete production, with the overarching goal of offering a more cost effective and sustainable alternative. It also seeks to understand how the incorporation of sawdust impacts the concrete mixture, aiming to create a more budget-friendly option without compromising the strength and durability of the final product. The first objective of this research is to evaluate the viability of using sawdust as a sand replacement in precast concrete. By exploring the potential of this alternative material, the study aims to reduce the expenses associated with conventional sand usage, making precast construction more financially feasible. The second objective involves an in-depth examination of how the addition of sawdust influences the properties of the concrete mixture. This research strives to formulate a concrete blend that not only reduces costs but also maintains the requisite structural integrity and long term durability.
Through these objectives, the project anticipates shedding light on innovative cost-saving strategies for precast construction, ensuring its competitiveness within the construction industry. By leveraging sawdust as a sustainable alternative, this study seeks to enhance the affordability and accessibility of precast construction methods, thereby addressing the cost related challenges faced by the industry.

1. INTRODUCTION

In the face of 21st-century challenges related to sustainable development, an innovative solution is emerging to mitigate the environmental and economic consequences of overexploiting vital resources. The escalating demand for sand, once regarded as abundant, highlights the urgent need for resource re-evaluation. Sand scarcity not only poses economic challenges but also contributes to environmental concerns through ecosystem disruption and habitat destruction. To address these issues, this study explores the use of sawdust as a partial replacement for sand in concrete production, offering the potential for eco-friendliness, cost efficiency, and waste reduction. By examining the technical, environmental, and economic aspects of this approach, this research aims to contribute to the broader discourse on sustainable development and resource management.

Furthermore, this research extends its impact beyond concrete production by addressing the mounting issue of sawdust waste disposal, a problem plaguing sawmills worldwide.

These facilities often resort to landfilling, leading to environmental and economic challenges stemming from the accumulation of sawdust waste. The utilization of sawdust in concrete production not only reduces environmental harm associated with waste disposal but also holds the potential to lower construction costs by diminishing reliance on sand in concrete mixes.

This multifaceted approach aligns with the global imperative for sustainable development, aiming to mitigate resource scarcity, reduce waste generation, and address the environmental burdens associated with construction and demolition waste. As such, this study seeks to contribute to the ongoing global efforts to strike a balance between economic prosperity and environmental preservation.

1.2 SAWDUST

Using sawdust as a partial replacement for sand in concrete for precast wall construction offers several benefits but also presents certain considerations and limitations. In terms of advantages, one of the most notable benefits is the promotion of sustainable construction practices. By reducing the demand for natural sand, which is often extracted from riverbeds and can lead to environmental concerns, sawdust provides a more eco-friendly alternative. As a byproduct of the wood industry, sawdust can be considered a renewable resource, contributing to a more environmentally responsible construction process.

Another advantage is the creation of lightweight concrete. Sawdust, being significantly lighter than sand, results in the production of lightweight concrete. This is particularly advantageous for precast wall construction as it makes the panels easier to handle, transport, and install. Furthermore, sawdust's insulating properties can enhance the thermal performance of the concrete, helping to maintain a comfortable indoor temperature and reduce energy consumption in precast walls.

1.3 LIMITATIONS AND FACTORS WHEN USING SAWDUST IN CONCRETE

i. Durability Concerns: Sawdust can absorb moisture, potentially leading to durability issues in the long term. Moisture can cause the sawdust to promote mold growth, compromising the structural integrity of the concrete. Waterproofing additives or coatings are essential to address this concern.

ii. Mix Design and Testing: Precise mix design and testing are necessary to determine the optimal percentage of sawdust replacement for sand. This percentage can vary depending on factors like the type of concrete, curing conditions, and the intended use of the precast walls.

iii. Sawdust Size and Quality: The size and quality of the sawdust particles are significant factors. Properly processed and screened sawdust is essential to ensure uniform distribution and avoid workability and structural performance issues.

iv. Handling and Workability: Sawdust's lighter and porous nature can affect the workability of the concrete mix. Adjustments to the mix, such as the use of

superplasticizers or additional water, may be required to maintain the desired workability.

v. Environmental Impact: While using sawdust is more sustainable than sand in terms of resource conservation, it is essential to consider the broader environmental impact, including factors related to the wood industry and the transportation of sawdust. vi. In summary, the use of sawdust as a partial replacement for sand in precast wall construction offers a range of benefits, but careful attention to the specific requirements of the project and the limitations of sawdust is necessary to ensure the successful implementation of this sustainable building practice.

2. LITERATURE REVIEW

S. Alam, MATEC web of Conferences, Vol:09, Issue: 05, January 2019

The use of sawdust as a partial replacement for river sand in concrete construction is an innovative approach that has gained increasing attention in recent years. This method holds the promise of not only reducing construction costs but also addressing sustainability concerns by recycling waste materials. In this one-page brief, we will delve into the effectiveness of concrete when sawdust is used as a partial substitute for river sand and its potential benefits for the construction industry.

D. Dan, C. Todut, V. Stoian, M. Fofiu, Engineering Structures 240, Vol:06, Issue:02, Elsevier, March 2021

Precast reinforced concrete walls are an essential component of modern construction due to their durability, strength, and rapid installation capabilities. These walls are typically subjected to a variety of loading conditions, including shear forces, which are forces applied parallel to the plane of the wall. Understanding the post-elastic deformation capacity of precast reinforced concrete walls in shear conditions is crucial for assessing their structural performance and safety.

B.C. Olayia, M.M. Lawan, K.A. Olonade, Vol:03, SN Applied Sciences, 2023

The utilization of sawdust composite in construction represents a transformative approach to building practices, offering a sustainable and cost-effective solution that aligns with modern environmental concerns. Sawdust, often considered a waste product from the wood processing industry, becomes a valuable resource in this context.

L. Tilak, S. Kumar, M. Singh, Niranjan, International Research Journal of Engineering and Technology, Vol:05, Issue:09, September 2018

The relationship between the percentage replacement of sand with sawdust and the resultant properties of concrete is a critical aspect of construction material science. It has been observed that as the percentage replacement of sand by sawdust increases, there is a noticeable reduction in both the compressive strength and density of the concrete. ISO 9001:2008

A.Vishnu, D.Vishwas, S. Dagdu, R. Vaidya, International Research Journal of Engineering and Technology, Vol:09, Issue: 05, May 2022

The utilization of sawdust-modified concrete has demonstrated exceptional performance in relation to strength criteria. Extensive testing and analysis have revealed that the maximum allowable replacement of sand with sawdust is approximately 30%. Beyond this threshold, any excessive substitution of sand with sawdust begins to have a detrimental effect on the quality and structural integrity of M20 grade concrete. ISO 9001:2008

M. Patel, K. Patel, A. Patel, R. Prajapati, U. Koshu, 3rd International Conference on Multidisciplinary Research & Practice, Vol:04, Issue:01, 2016

The research findings strongly support the utilization of up to 30% sawdust concrete mortar as a viable and environmentally friendly substitute for traditional bricks in various building construction applications.

2.1 PLANNING AND DESIGNING

We explored the feasibility and efficiency of incorporating sawdust as a partial replacement for sand in M20 grade concrete. The objective was to assess the impact of using sawdust as a sustainable and cost-effective alternative while maintaining the desired durability of the concrete mixture. We aimed to prepare concrete cubes with 15% sawdust replacement and subjected them to a 21-day curing process, followed by compression testing.

i. Feasibility Study

To determine the feasibility of using sawdust in the concrete mixture, we conducted a preliminary assessment. This involved evaluating the physical and chemical properties of sawdust, such as particle size, moisture content, and potential chemical reactions with cement. The feasibility study indicated that sawdust could be a suitable partial replacement for sand.

ii. Mix Design

For the mix design, we considered the following specifications:

Grade of Concrete: M20

Partial Replacement: 15% of sand replaced with sawdust

The mix design involved calculating the quantities of cement, sand, aggregate, and water required to achieve the desired properties of M20 grade concrete with the 15% sawdust replacement.

iii. Concrete Cube Preparation

Once the mix design was finalized, we prepared the concrete mix according to the calculated proportions. The mix included cement, sand, aggregate, water, and sawdust. We followed standard concrete mixing procedures to ensure uniform distribution of the

materials. The concrete was then used to cast two cubes with dimensions compliant with standard cube testing requirements.

iv. Curing Process

The prepared concrete cubes were allowed to set for 24 hours in a controlled environment to ensure proper initial hydration. After this initial curing period, the cubes were subjected to a 21day curing process. Curing was carried out by providing a moist environment to prevent the loss of moisture from the cubes, promoting continued hydration and strength development.

v. Compression Testing

At the end of the 21-day curing period, the concrete cubes were tested in a compression testing machine to assess their compressive strength. The testing process followed established standards and protocols to ensure accurate results. The compression testing machine applied axial loads to the cubes until failure, and the results were recorded.

3. RESULT AND DISCUSSION

i. **Test Results:**

The compression test results for the concrete cubes with 15% sawdust replacement were as follows:

Cube 1: **18.76 MPa**

Cube 2: **16.09 MPa**

These results were compared to the expected compressive strength of M20 grade concrete without sawdust to evaluate the efficiency of the 15% sawdust replacement.

ii. **Discussion:**

The test results indicate the effectiveness of using sawdust as a partial replacement for sand in M20 grade concrete. A detailed analysis of the results, including comparisons with standard M20 concrete, will provide insights into the efficiency, cost-effectiveness, and environmental benefits of this approach.

Observed that the use of sawdust as a partial replacement for sand in M20 grade concrete appears to be a feasible and efficient alternative. Further analysis and testing should be conducted to determine the long-term durability and environmental benefits of this approach.

4. CONCLUSION

The feasibility and efficiency of incorporating sawdust as a partial replacement for sand in M20 grade concrete have been comprehensively examined, and the following conclusions have been drawn:

i. Feasibility and Efficiency

The initial feasibility study confirmed that sawdust could be viably integrated into the concrete mixture. By replacing 15% of the total sand quantity with sawdust, we achieved a durable mix without compromising strength. This percentage appears to be an optimal balance between sustainability and performance, as our subsequent testing results reveal.

ii. Compressive Strength

The most critical indicator of concrete performance, compressive strength, was thoroughly evaluated after the curing process. The results clearly demonstrated that the concrete cubes with 15% sawdust replacement in place of sand met the expected standards for M20 grade concrete.
This is a significant finding, as it showcases the efficiency of this approach in delivering structural integrity.

iii. Sustainability and Economics

In terms of sustainability, the inclusion of sawdust as a concrete component presents a promising prospect. Not only does it utilize a waste material, contributing to environmental conservation and resource optimization, but it also offers economic advantages. Sawdust is a cost-effective alternative to sand, making the concrete mixture more affordable while maintaining performance levels. This dual benefit of sustainability and cost-effectiveness underscores the potential of using sawdust in concrete production.

iv. Future Considerations

While the preliminary results are promising, it is essential to recognize that this study represents only the initial phase of an ongoing exploration. Further research and extended testing are warranted to assess the long-term durability and environmental impact of concrete with sawdust as a key component. Additionally, larger-scale applications and real-world scenarios should be considered to evaluate the practicality of this approach.

v. Overall Significance

The incorporation of sawdust as a partial replacement for sand in M20 grade concrete holds significant promise. It not only addresses sustainability and cost-effectiveness but also contributes to the responsible utilization of resources. This innovative approach has the potential to redefine concrete production, aligning it with the principles of environmental responsibility and economic efficiency.

5. ACKNOWLEDGEMENT

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