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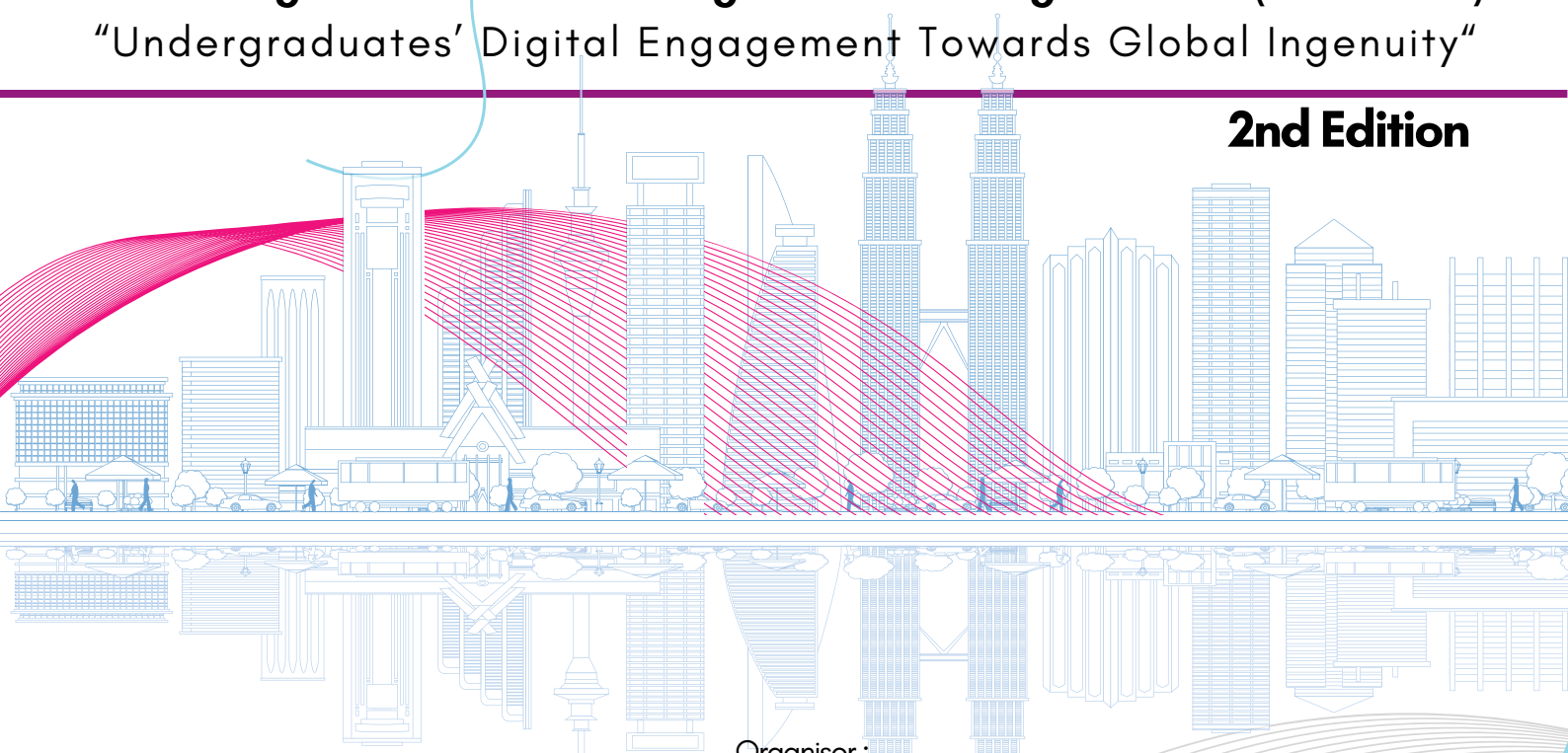
"Undergraduates' Digital Engagement Towards Global Ingenuity"

2nd Edition



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Co-organiser :

INSPIRED 2024. Office of Research, Industrial Linkages, Community & Alumni (PJIMA), UiTM Perak Branch

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PADDY STRAW OF PRECAST WALL

Nur Anis Nadhirah Zahari[1], Mohd Najib Abd Rashid[2*], and Muhammad Naim Mahyuddin[3]

[1 2 3]Department of Built Environment Studies and Technology, College of Built Environment
Universiti Technology MARA Perak Branch, Seri Iskandar Campus

*mohdn613@uitm.edu.my

Abstract
The innovation project report titled Paddy Straw of Precast Panel explores the potential of utilizing paddy straw, a by-product of rice cultivation, as an eco-friendly alternative in the construction industry, specifically in the production of precast wall panels. With rice cultivation generating approximately 800 million tons of straw globally, the improper disposal of this biomass, often through open burning, poses significant environmental challenges, including greenhouse gas emissions and air pollution. This study aims to address the pressing issue of paddy straw waste management by investigating its incorporation into construction materials, thereby promoting sustainable practices. The research evaluates the mechanical properties of paddy straw cement composites, highlighting their strength, and acoustic properties. The project also emphasizes the importance of sustainable development in construction, aligning with global goals to reduce waste and enhance resource efficiency. Through comprehensive testing and analysis, the study seeks to demonstrate that paddy straw precast panels can not only reduce environmental impact but also enhance the performance of construction materials, thereby contributing to a more sustainable and economically viable construction sector. The findings aim to facilitate greater awareness and adoption of innovative building materials, ultimately supporting Malaysia's sustainability efforts in agriculture and environmental conservation.

Keywords: *Paddy straw, Sustainability, Environmental*

1. INTRODUCTION

The following paper is about the use of paddy straw, which is a by-product of rice cultivation, in the construction of precast wall panels within the IBS framework. Structural properties and environmental advantages concerning the incorporation of paddy straw into building materials that increase sustainability concerns with conventional construction practices will be studied in developing such. Specifically, it is intended to assess the strength and performance of paddy straw panels as compared to conventional material to determine areas of probable application in construction. Precisely, this study will focus on the problem associated with the current disposal of paddy straw through open burning in Malaysia, which contributes to considerable environmental pollution and health hazards. This unsustainable paddy-straw management system loses the opportunity to tap its potential in eco-friendly applications. Thus, the present research work aims to provide a viable alternate solution by studying the potential applications of paddy straw in precast wall panels for reduced environmental impact and improved material sustainability in construction.

2. LITERATURE REVIEW

Earlier studies have identified the scope of using natural fibers, including paddy straw, in construction material systems because of their eco-friendliness and availability. Research in using natural fibers has shown that the addition of the fiber improves mechanical properties in tensile strength and durability, improving environmental benefits related to reduced carbon emission and waste minimization of building materials.

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It builds on existing literature relating to the use of paddy straw in precast wall panels and evaluates their performance under various conditions.

2.1 Paddy Straw in Construction

Paddy straw, a byproduct of rice cultivation, has gained recognition as a sustainable building material due to its abundance and eco-friendly characteristics. It can be processed and combined with binders like cement, lime, or clay to create various construction materials, including precast wall panels and insulation boards. The structural properties of paddy straw, mainly its components such as cellulose, hemicellulose, and lignin, contribute to tensile strength and durability. When mixed with appropriate binders, paddy straw enhances the mechanical properties of building materials, improving compressive strength, flexural strength, and impact resistance, making it suitable for both load-bearing and non-load-bearing applications in construction.

2.2 Environmental Benefits

Utilizing paddy straw in construction offers several environmental benefits, primarily through waste reduction and promoting a circular economy by diminishing the need for open burning, which generates air pollution and greenhouse gas emissions. As a renewable resource produced annually in rice-growing regions, paddy straw provides a sustainable alternative to nonrenewable materials such as concrete and steel. Using paddy straw can help in the conservation of natural resources. Additionally, paddy straw composites have a lower carbon footprint due to less energy-intensive processing, contributing to climate change mitigation. Lastly, being biodegradable, paddy straw-based materials can decompose naturally without harmful residues, allowing for safe disposal or composting that enriches the soil and completes the material's life cycle.

3. METHODOLOGY

The methodology involves a comprehensive literature review, laboratory experiments, and data analysis to make up the methodologies followed here. The literature review forms a backdrop of available knowledge regarding the application of natural fibers in the construction industry. The laboratory experiments involve tests to determine several structural properties of paddy straw panels, such as compressive strength, density, and thermal insulation. Data analysis, in comparison with the performance of conventional materials, proves that paddy straw panels can be used for various construction applications.

4. RESULTS AND DISCUSSION

Concrete strength is measured by compressive and flexural tests. Furthermore, the compressive test is for cubes. The testing went successfully, with no odd events that may be interpreted as a mistake. The compressive strength for PS concrete and Normal concrete shows that on days 7 and 14.

Table 1. Result of Strength Concrete Test

Type of Concrete	7 Days	14 Days
Normal Concrete	26.5	27.8
2% of PS Concrete	27.6	28.4
4% of PS Concrete	11.7	14.5

From the data, it was found that the strength of 2% concrete paddy straw is higher than normal concrete. This indicates that the paddy straw innovation was successful but the results for 4% paddy straw showed low strength readings.

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After that, the cube was tested using the UPV test. The ultrasonic pulse speed (UPV) test is a method used to assess the structural integrity of lightweight concrete. It measures the speed at which ultrasonic pulses travel through the material, with higher values indicating better homogeneity and increased strength. The test is influenced by factors like concrete composition, curing conditions, and specimen geometry. Consistently increasing UPV over time indicates strength development, while a decrease may indicate potential issues like increased porosity or insufficient healing. Analysis helps in adjusting the concrete mix or curing process to meet specific application or structural element standards.

Table 2. Result of Ultra Pulse Velocity Test for 7 days

Type of concrete	Reading 1	Reading 2	Reading 3	Average
Normal Concrete	5181	4785	4367	5181
2% of PS Concrete	5208	4902	4367	5208
4% of PS Concrete	5181	5025	4464	5181

Table 3. Result of Ultra Pulse Velocity Test for 14 days

Type of concrete	Reading 1	Reading 2	Reading 3	Average
Normal Concrete	5181	4785	4367	5181
2% of PS Concrete	5208	4902	4367	5208
4% of PS Concrete	5181	5025	4464	5181

For 7 days shows that 2% of PS Concrete shows a slightly higher average UPV compared to Normal Concrete and 4% of PS Concrete, indicating potentially better initial quality. For 14 days shows that Normal Concrete exhibits a higher average UPV compared to both 2% and 4% of PS Concrete, suggesting that it may continue to develop higher strength and quality over time compared to the PS Concrete mixes. However, 2% paddy straw has an average result that is still in the excellent average quality of 4785.

Next, the density test was conducted. The tables below shows the result of density test measurements in both water and air. Density tests reveal its buoyancy and composition with lower air densities indicating buoyancy. This is important for applications that require reduced structural weight. The analysis considers factors such as concrete mix design, curing conditions, and aggregates. Density variations between samples were analyzed to determine the effect on structural performance durability.

Table 4. Result of Density Test Result for 7 days

Type of concrete	Air	Water
Normal Concrete	2419.9	1382.1
2% of PS Concrete	2160.0	1209.9
4% of PS Concrete	2157.0	1178.4

Table 5. Result of Density Test Result for 14 days

Type of concrete	Air	Water
Normal Concrete	2293.8	1304.9
2% of PS Concrete	2268.9	1281.6
4% of PS Concrete	2225.6	1220.5

Among these, the highest density is observed in the 4% of PS Concrete, which is approximately 1.831 g/mL. This suggests that the 4% of PS Concrete has a denser composition compared to both Normal Concrete and the 2% of PS Concrete mixes. Therefore, based on the density test results provided the 4% of PS Concrete shows the highest density, which is generally considered a favorable result in terms of concrete strength and durability.

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5. CONCLUSION

The panels contain agricultural waste, hence having several environmental and economic advantages. They reduce the carbon footprint associated with traditional concrete production and form an effective way of handling the waste of paddy straw that normally contributes to pollution when burned. Key advantages of paddy straw precast panels include improved energy efficiency and comfort in buildings that reduce weight making them cost-effective in many construction projects. Also, they are in line with green building practices and contribute to sustainability certifications, something the green developers and builders will like. Therefore, the potential use of agricultural waste, specifically paddy straw, in the construction industry, serves as an alternative source of sustainable building material. The environmental and economic benefits presented by this research work in paddy straw precast panels include reduced pollution by straw burning and reduced material cost, with improved insulation properties. Comparative tests showed that adding 2% paddy straw to concrete may improve the initial strength and quality, while 4% paddy straw increases density but might decrease the strength over time. The study concludes that the paddy straw precast panel is one such green solution, which would be able to meet all the green building parameters for sustainability certification and could be an attractive feature for environmentally conscious construction projects.

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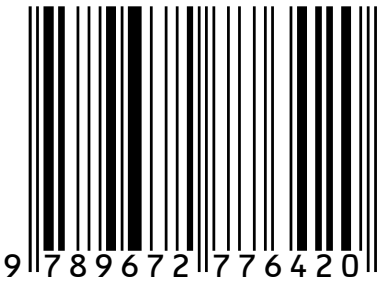

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