



BATAAN PENINSULA STATE UNIVERSITY
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Experimental Study on the Utilization of **Crushed Mussel Shells** as **Partial Replacement** for **Fine Aggregates** and **Rice Husk Ash** as a **Partial Replacement** for **Cement** on the Production of **Pavement Bricks**



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Circular Innovation Overview

The concept for this project was born when we first learned that Bataan is one of the hot spots for both aquaculture and agriculture ecosystems, serving as the main source of living within the community. Moreover, Region III, Central Luzon, ranked number one in the 2020 shellfish production by Region having approximately 39,000 metric tons produced as shown in Figure 1a. Locally, in Bataan, Abucay and Mariveles were included in 32 mollusk farming areas in the Philippines from natural ground, farming areas, to potential sites, according to FAO (food and agriculture organization). On the other hand, palay production in the year 2021 marked the municipality of Hermosa and Dinalupihan as the highest palay-producing municipality in Bataan having over 15,500 metric tons production.

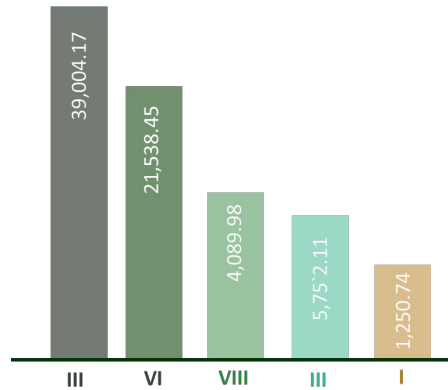


Figure 1a. 2020 Shellfish Production Data By Region (PSA)

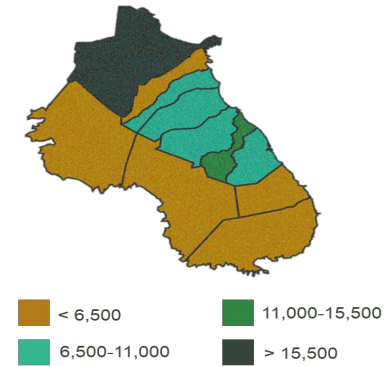



Figure 1b. Palay Production in Bataan by Municipalities (PHILRICE, 2021)

Project Goals



GENERAL OBJECTIVE

To utilize and **investigate crushed mussel shells** as partial replacement for fine aggregates and **rice husk ash** as a partial replacement for cement in the production of **pavement bricks**.



To analyze the performance of crushed mussel shells as partial replacement for fine aggregates and rice husk ash as partial replacement for cement



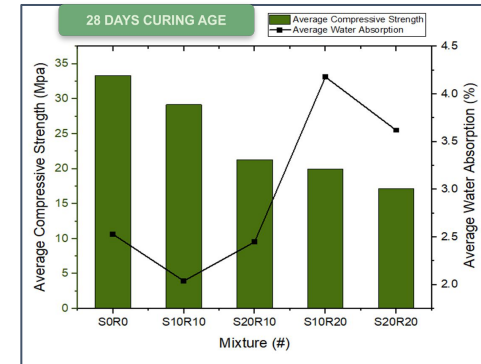
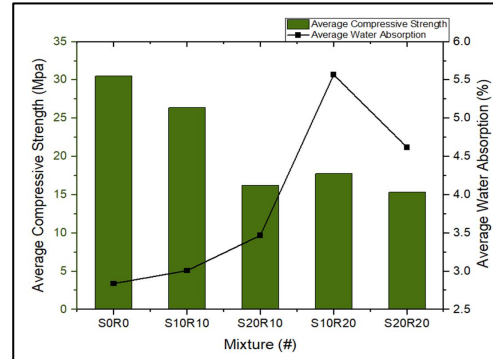
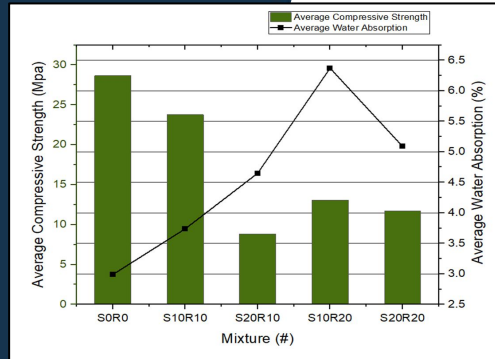
To test the mechanical properties of the product (Compressive Strength and Water Absorption) and compare and assess the results.



To determine the optimum design mixture for the production of pavement bricks with (Crushed mussel shell + Rice husk ash).

Impact & Results

The experimental analysis indicates that the compressive strength of concrete decreases as the partial replacement of fine aggregates with crushed mussel shells and partial replacement of cement with RHA increases. Compliant with the ASTM standards, the leading mix identity (with crushed mussel shell + RHA) that gave the optimum compressive strength, and water absorption percentage were observed at S10R10 mix at 28 days curing age where 10% partial replacement of fine aggregate with crushed mussel shells and 10% partial replacement of cement with RHA. This study would help construction experts to use such wasted aquaculture and agriculture byproducts in the production of new pavement bricks.



Impact & Results

Fabricated Paving Brick Specimens



With 10% Mussel Shells and 10%
Rice Husk Ash



With 20% Mussel Shells and 10%
Rice Husk Ash



With 10% Mussel Shells and 20%
Rice Husk Ash



With 20% Mussel Shells and 20%
Rice Husk Ash

Micro Grant

The purpose of our project is to study the effect of application of mussel shells and RHA as partial replacement for fine aggregates and cement, respectively. By doing this, we minimize trash from mussel shells and rice husk which is one of the main products in our province. We also aimed to reduced reliance to raw materials. Micro grant gave us support on this research project. This sponsorship program from Circular Cities Asia and The Regional Project Energy Security and Climate Change Asia- Pacific (RECAP) made a tremendous impact on our way on making our research from initial gathering of our materials needed to the result of our designed mixture. It helped us to finished the research successfully.



Lessons Learnt

The knowledge and experience our team have gained from this project can prove highly beneficial to the success of our projects in the near future.

This project taught our team how to understand problem situations, and how to bring solution on certain problems that exists in our society. But, the highlight of our learning as a result of this project really focuses on **teamwork**— the collective knowledge of the team that enabled better problem solving. Our team **experienced a lot of setbacks** in terms of schedules and testings, we were able to focus and regain perspective. It taught our team a lot about adaptability that is deeply rooted with the **trust we have in our team.**

Stories



Krisha Mae T. Inieto

“Seizing the opportunity to **acquire knowledge** is crucial for achieving success. By this program, we enhance our ability to create, invent, and introduce innovative concepts and ideas. As part of the team, I am immensely grateful that our team has been selected to receive micro grant from the Circular Campus Program. Through this, we are able to pursue our research project successfully. I would like to express my most sincere appreciation and extend a heartfelt thank you for this remarkable opportunity.”

“Being chosen to experience the Circular Campus Programme **sparked** not only my interest into further giving awareness about circular economy, but also my **curiosity** into finding out more ways to innovate while immersing the concept of sustainability & circularity. The success of this project wouldn't be easy to reach if not for the micro grant that aided us financially into completing this project. I express my deepest gratitude, thank you very much for this great opportunity.”



John Dale C. Jornal



Michaela Faye I. de Leon

“ I want to express my sincere thanks and immense gratitude for the opportunity presented by Circular Cities Asia. The execution of our team's concepts and ideas were made possible through the financial support provided. It enabled us to achieve results and make significant step towards our intended objectives.”



Next Steps

1. Conduct another study investigating the **life cycle of concrete pavement bricks** with crushed mussel shell as partial replacement for fine aggregates and rice husk ash as partial replacement for cement.
2. Another research should be studied for the **development of locally-base crushed mussel shell aggregate and rice husk ash cement brick manufacturing machine** in support of the bricks production to be initially established.