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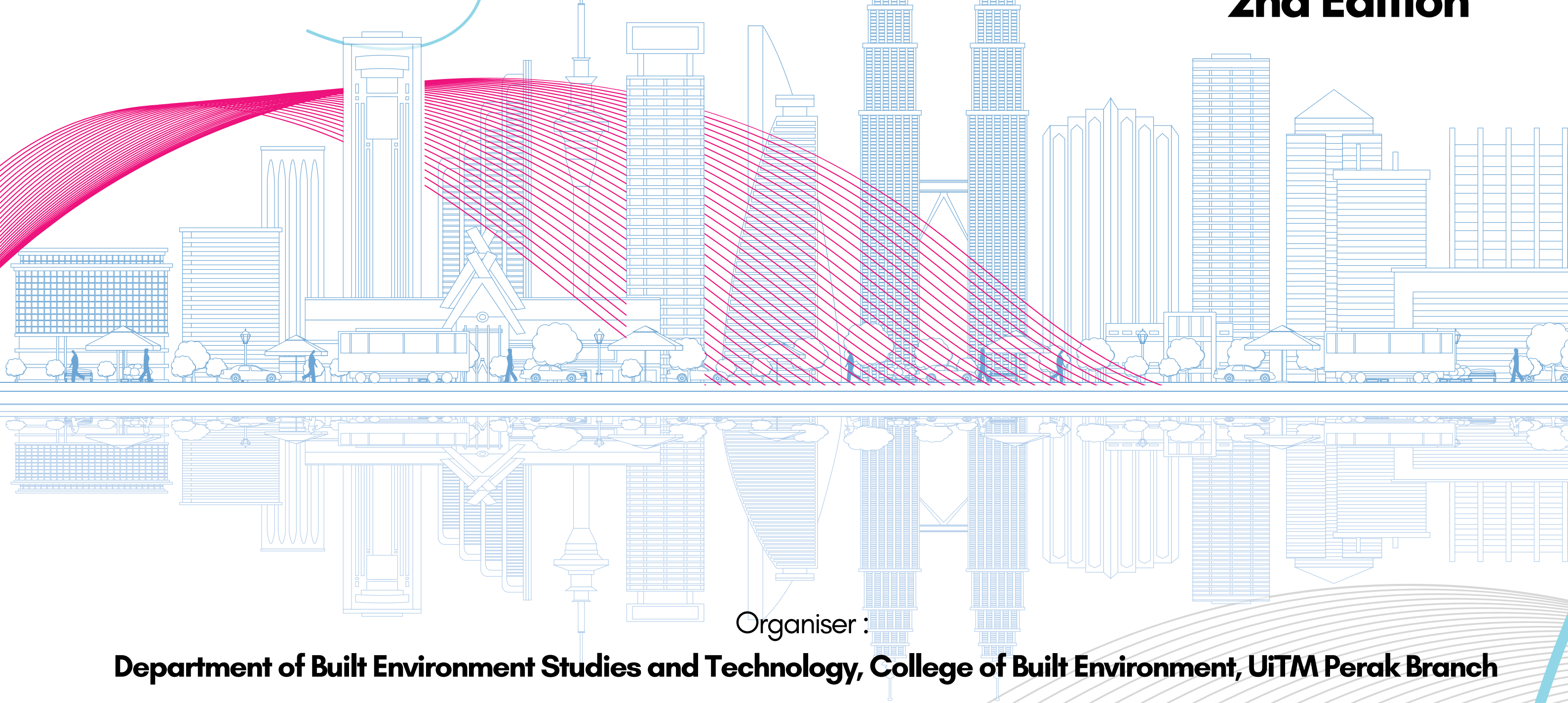
# e - Proceedings

IUGeT

## Proceeding for International Undergraduates Get Together 2024 (IUGeT 2024)

"Undergraduates' Digital Engagement Towards Global Ingenuity"

**2nd Edition**



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

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# ECOASH PRECAST: AN APPLICATION OF PALM OIL FUEL ASH (POFA) IN PRECAST CONCRETE COMPONENT

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**Abstract**
Precast concrete component, created in controlled environments and transported to construction sites, offer consistent quality, durability, and customization, making them ideal for various building projects and infrastructure, while reducing on-site labour and costs, despite potentially higher initial expenses due to their long-term efficiency and sustainability. High temperatures in Malaysia, reaching up to 41°C impact cement production, and a shortage of wet gunny (fiber) used to cool concrete exacerbates the issue, while waste management challenges, particularly from the palm oil industry, contribute to environmental pollution and health risks. The present issues with concrete mixtures in precast components can be assessed through thorough material testing, quality control, and performance evaluation. Palm oil fuel ash (POFA) can enhance concrete mixtures by improving strength, durability, and sustainability which is known as ECOASH precast. The market potential of ECOASH is significant due to its cost-effectiveness, environmental benefits, and improved performance characteristics.

**Keywords:** *concrete mixture, Palm Oil Fuel Ash (POFA), Precast concrete*

## 1. INTRODUCTION

This study primarily investigates the use of Palm Oil Fuel Ash (POFA) in precast concrete components. By examining the possibility of using POFA in place of some of the cement in precast concrete, this study seeks to meet the growing needs for environmentally friendly and sustainable building materials. The effects of conventional cement production on the environment are specifically discussed, along with the possible advantages of using agricultural waste materials like POFA to lessen these effects.

The environmental and financial advantages of using agricultural waste products in the manufacturing of concrete have been the subject of numerous studies. For example, studies conducted in 2013 by Awal and Shehu showed that POFA, a waste product from palm oil mills, might improve the compressive strength and longevity of concrete. These results have been supported by additional research, which indicates that POFA can lessen permeability and increase concrete's resistance to sulphate assault (Tangchirapat et al., 2007; Ismail et al., 2010).

The procedures used in this investigation comprised gathering and processing POFA, combining it in different ratios with cement, and pouring the mixture into conventional precast concrete moulds. The compressive strength, flexural strength, water absorption, and sulphate resistance of the concrete specimens are next assessed using a battery of tests. To evaluate POFA's effectiveness as a cement substitute, a comparison is made between POFA-incorporated and conventional concrete.

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The primary findings of this study suggest that the mechanical qualities and durability of precast concrete components can be greatly improved by adding POFA. According to the testing results, concrete with up to 15% POFA has better flexural and compressive strength than regular concrete. Furthermore, POFA-incorporated concrete exhibits enhanced resistance to sulfate attack and decreased water absorption, indicating that it is a good fit for sustainable building applications.

## 2. LITERATURE REVIEW

Large amounts of agricultural waste are produced globally, which presents environmental problems. These waste materials do, however, also provide chances for sustainable use in a variety of applications, supporting initiatives for resource conservation and trash management. The purpose of this literature study is to examine the possible applications of agricultural waste materials, such as rice husk, rubber, bamboo, sugarcane bagasse, and others, in various industries.

It is impossible to define "agricultural sustainability" in one way. The ability of agricultural systems to meet varying needs over time is, in any event, widely acknowledged in science as agricultural sustainability, as Hansen (1996) explains. Nevertheless, it is important to note that there are a number of issues with this concept of sustainability that prevent it from being empirically applied in everyday situation. Initially, we need to address sustainability's temporal dimension. Moreover, since long-term trials are impractical, the definition of sustainability, which is associated with the preservation of production capacity, is practically meaningless. Secondly, the challenge is in pinpointing the needs that the agriculture sector needs to meet for it to be considered sustainable. Thus, sustainability can be understood as a social construct that can be adjusted to meet societal needs. As a result, the idea of sustainability needs to be understood as being particular to both location and time. These two challenges have reduced this concept's use as a standard to direct agricultural development (Ismail Khalife, 2024)

## 3. METHODOLOGY

The concrete mix preparation process involves several crucial steps to ensure the desired properties and quality of the final product. It begins with the selection of raw materials, including water, coarse aggregate, fine aggregate, and POFA as an admixture. These materials are carefully proportioned to achieve the specific characteristics required for the concrete mix.

Due to the small batch size of only nine cubes, the mixing process is carried out manually using a shovel. This method allows for a thorough and even distribution of all ingredients, resulting in a consistent and workable concrete mixture. The mixed concrete is then poured into molds at the workshop, with great care taken during placement to prevent segregation of the materials.

After placement, the concrete undergoes compaction to eliminate air pockets and ensure it conforms to the shape of the molds. This process is achieved using vibrators, which effectively consolidate the concrete. Once compacted, the concrete is allowed to harden in the workshop, a crucial step that follows both the placement and compaction processes. This hardening period allows the concrete to develop its strength and durability.

Finally, the cured concrete is carefully removed from the molds to avoid any damage, ensuring the integrity of the freshly created concrete. This step marks the completion of the concrete mix preparation process, allowing the experimental procedure to progress to the next phase.

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## 4. RESULT AND DISCUSSION

The ECOASH precast is a product made by combining POFA, a waste product from the palm oil sector, with precast crushed concrete that is produced from IBS and precast factories. In addition to having a slight negative environmental impact, the use of ECOASH precast increases the material's strength and durability because it uses a waste product that would otherwise be thrown. This product lowers the cost of paving materials and improves their environmental friendliness, making it a viable choice for many applications.

The result of density test, UPV, and compressive strength analyses were conducted under the performance subtopic to support the nation that a novel precast concrete component that uses POFA can be utilized as proof the product's performance as shown in Figure 1, 2 and 3.

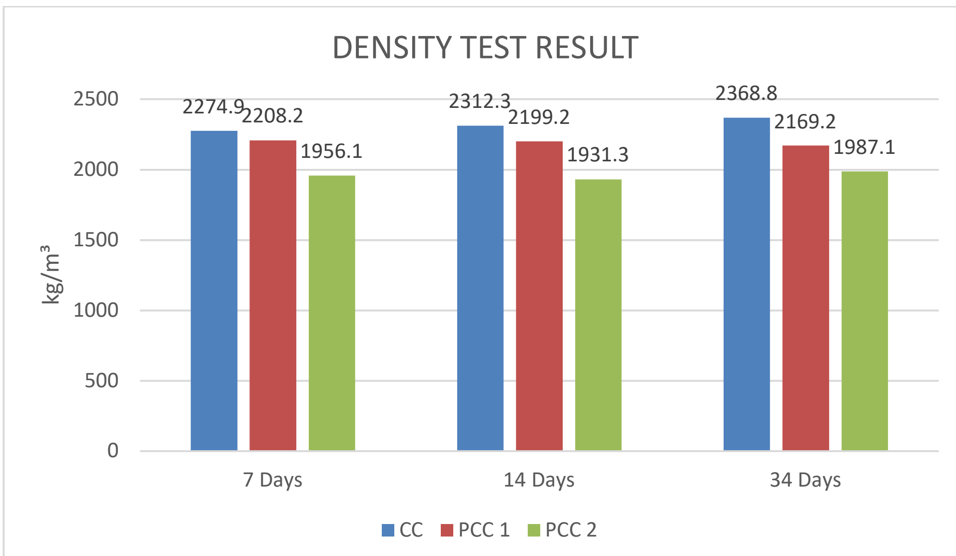


Figure 1: Result of Density Test for the ECOASH precast

To determine concrete density, where the mass of the filled container is measured, and the empty container's mass is subtracted to find the concrete's mass. This mass is then divided by the container's volume. The result is usually presented in pounds per cubic foot ($lb/ft^3$) or kilograms per cubic meter ($kg/m^3$). For example, if the concrete mass is 24 kg and the container volume is 0.01 $m^3$, the density is 2400 $kg/m^3$. Higher density often indicates stronger material, making the density measurement crucial for ensuring concrete meets construction standards. Therefore, the result shown PCC 1 which is 10% of POFA is clearly good between PCC 2 which is 15% of POFA.

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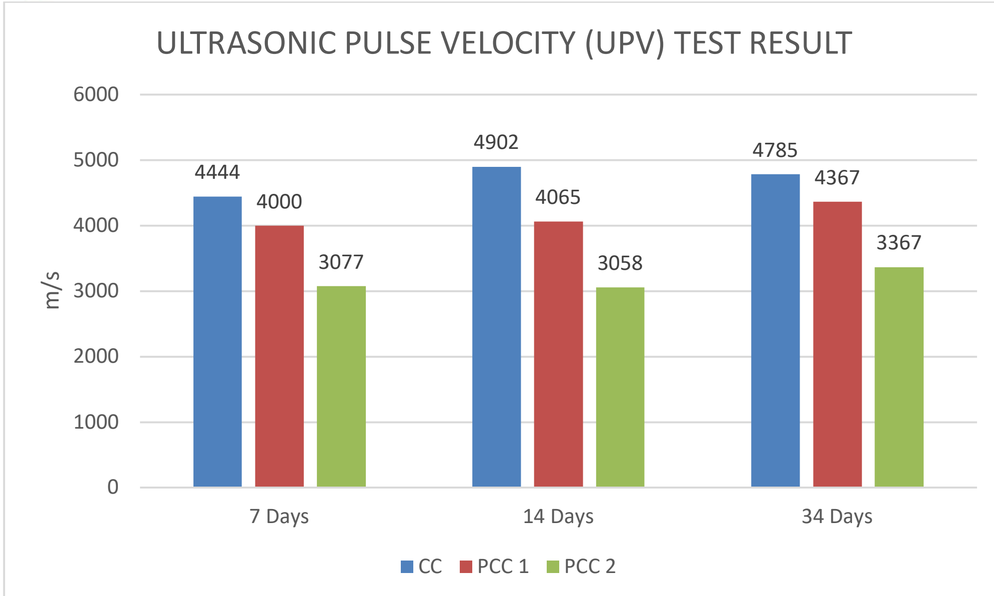


Figure 2: Result of UPV for the ECOASH precast

The ultrasonic pulse velocity (UPV) test measures the speed of ultrasonic pulses through concrete, expressed in meters per second (m/s). Transducers positioned on opposite sides of the concrete send and receive pulses, with a coupling agent enhancing transmission. The time taken for a pulse to travel between transducers is recorded. The pulse velocity is calculated using the formula V=DTV = \frac{D}{T}V=TD, where DDD is the distance and TTT is the travel time. For example, if the distance is 0.5 meters and the travel time is 0.0002 seconds, the pulse velocity is 2500 m/s. Therefore, the result of UPV test for the ECOASH precast shown the PCC 1 which is 10 % POFA better than PCC 2 which is 15% of POFA.

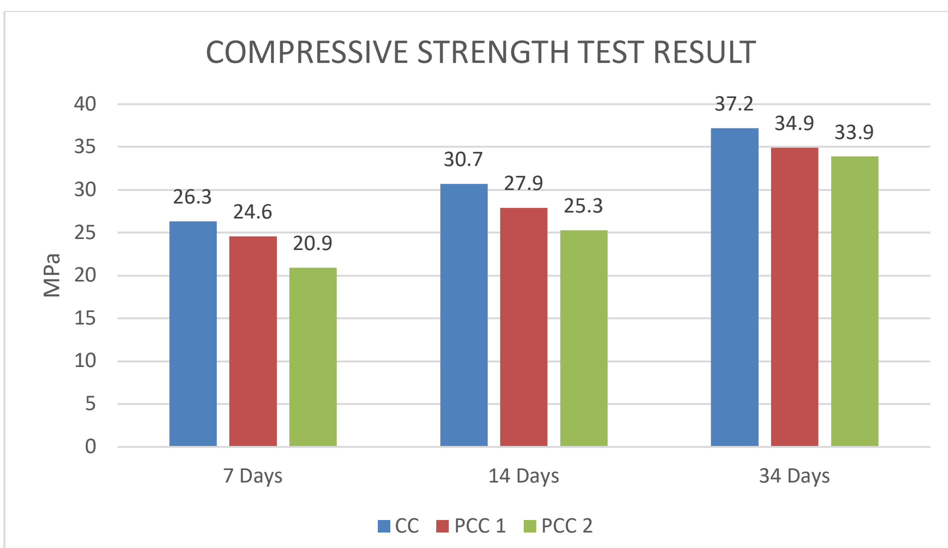


Figure 3: Result of Compressive Strength Test for the ECOASH Precast

The compressive strength test evaluates a material's or structure's resistance to loads that tend to compress it. It entails exerting force on a sample until it breaks; a compression testing machine is usually used for this. After inserting the sample—typically a concrete cube into the equipment, a load that increases gradually is applied. The test yields important information on the strength properties of the material, which is essential for creating structural elements that are both secure and effective. The compressive strength test results aid in determining if the concrete mix satisfies the necessary requirements and performance standards. Therefore, the result of compressive strength test for the ECOASH precast showing a significant increase for PCC 1 which is 10% of POFA compared to PCC 2 which is 15% of POFA

## 5. CONCLUSION

ECOASH Precast concrete components' mechanical qualities and endurance are greatly improved by adding POFA, according to the study's underlying concepts and generalizations. More specifically, concrete that has up to 15% POFA substitution exhibits enhanced resistance to sulfate attack, decreased water absorption, and improved compressive and flexural strength. These enhancements imply that POFA can function as a feasible cement substitute in precast concrete applications, encouraging resource efficiency and sustainability in building. The work theoretical ramifications support notions about sustainable materials and waste management by extending our understanding of the potential applications of agricultural waste materials in construction. In practical terms, POFA can minimize environmental effect, cut building costs, and lessen dependency on traditional cement in precast concrete components. This is in line with international initiatives to create greener building techniques and lessen the construction sectors carbon footprint for ECOASH precast concrete component.

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