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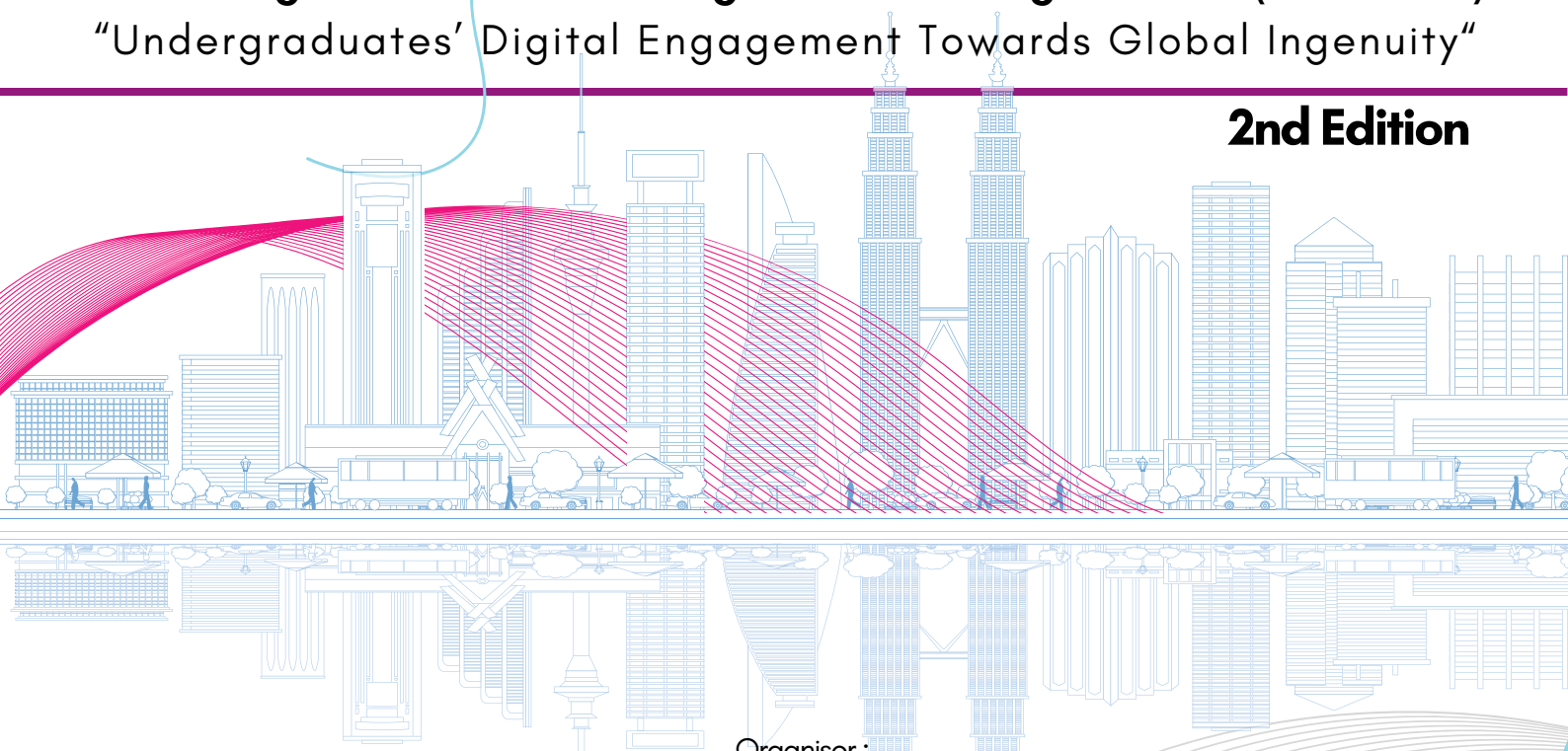
# IUGeT

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

"Undergraduates' Digital Engagement Towards Global Ingenuity"

**2nd Edition**




Organiser :

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**November 2024**

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Perpustakaan Negara Malaysia Cataloguing in Publication Data

No e- ISBN: 978-967-2776-42-0

Cover Design: Muhammad Anas Othman
Typesetting : Arial

e-ISBN: 978-967-2776-42-0

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e-ISBN: 978-967-2776-42-0

# DEVELOPMENT OF ECOLITE BLOCKS: UTILISING LIGHTWEIGHT FOAMED CONCRETE AND PALM OIL FUEL ASH FOR SUSTAINABLE CONSTRUCTION

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**Abstract**

The innovative work "Development of EcoLite Blocks: Utilising Lightweight Foamed Concrete and Palm Oil Fuel Ash for Sustainable Construction" explores a sustainable approach to construction materials by incorporating environmentally friendly components. This study focuses on the development of EcoLite Blocks, which employ lightweight foamed concrete as the primary matrix, enhanced by the inclusion of palm oil fuel ash (POFA) as a partial replacement for conventional cement. The research aims to boost the mechanical properties and overall sustainability of the EcoLite Blocks through the utilisation of these alternative materials. By investigating the effects of POFA on the blocks' compressive strength, durability, and other pertinent properties, the work seeks to provide insights into a greener and more resource-efficient construction practice. The findings of this study hold potential implications for the construction industry's efforts to reduce its environmental footprint while maintaining structural integrity and performance.

**Keywords:** *EcoLite Blocks, lightweight foamed concrete, palm oil fuel ash (POFA), sustainable construction.*

## 1. INTRODUCTION

Traditional construction materials pose significant environmental challenges, including high carbon dioxide emissions and intensive resource use (Paris et al., 2016). The application of POFA, a by-product of palm oil production, in concrete serves as a sustainable alternative to reduce the reliance on cement, thus minimising environmental footprints (Abdullah et al., 2012). This study investigates the potential of POFA incorporated into lightweight foamed concrete to produce environmentally friendly IBS blocks, which are crucial in modular construction systems.

## 2. MATERIALS AND METHODS

The study involves creating mixtures of lightweight foamed concrete with 0%, 10%, 15%, and 20% POFA replacing ordinary Portland cement. The blocks are then subjected to a series of tests to measure their density, ultrasonic pulse velocity (UPV), compressive strength, and other relevant properties over curing periods of 7 and 28 days. Figure 1, Table 1, and Figure 2 illustrate the constituents of materials, testing methods, and sample preparation procedures for the production of EcoLite Blocks, respectively.

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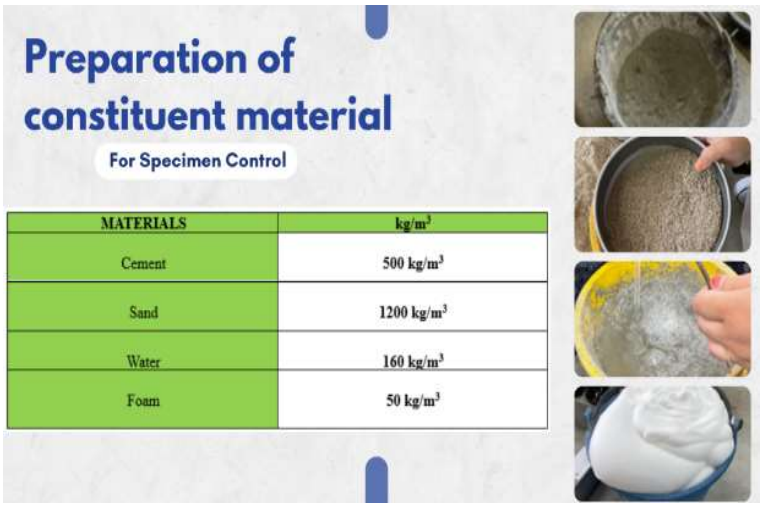


(a)


(b)

Figure 1: Constituents of materials: (a) control mix; (b) lightweight concrete with POFA mixes

Table 1: List of tests

| Properties | Name of test | Standard Testing Methods |
|---|---|---|
| Engineering Properties | Slump-test | BS EN 12350–2 |
| | Density | BS EN 12390-7:2019 |
| | Compressive strength | BS EN 12390-4 |
| | Ultrasonic pulse velocity | BS EN 12504-4:2004 |

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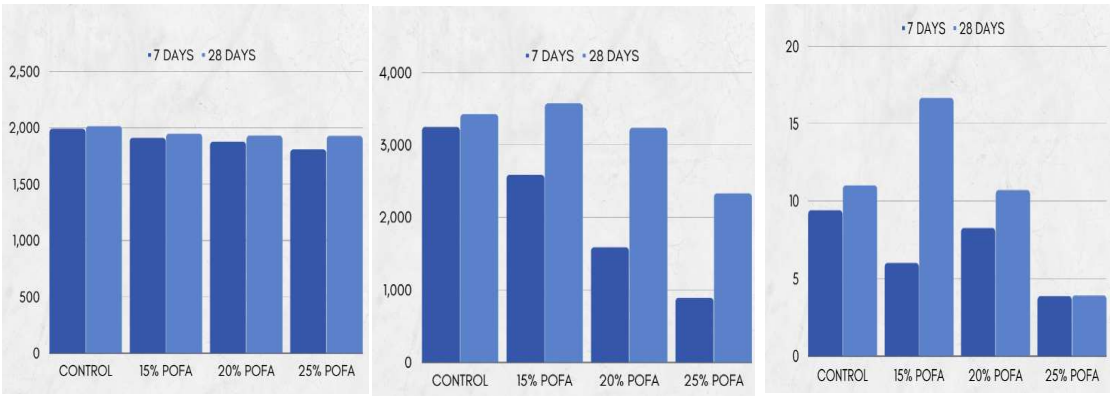
Figure 2: Sample preparation

## 3. RESULTS AND DISCUSSION

The average density test results show that the density of concrete blocks decreases as the percentage of POFA increases, highlighting the lightweight nature of the material. UPV test results indicate that the 15% POFA series exhibits superior performance, with the highest UPV values both at 7 and 28 days, suggesting better quality and uniformity of concrete. The compressive strength tests reveal that the 20% POFA mix performs best at 7 days, whereas the 15% POFA mix excels at 28 days, surpassing all other mixes, including the control. The performance of EcoLite Blocks is shown in Figure 3.




(a) (b) (c)

Figure 3: Performances of EcoLite Block (a) density test (b) UPV test (c) compressive strength test

The findings suggest that incorporating up to 15% POFA not only contributes to lighter blocks but also enhances certain mechanical properties, making it a viable alternative in the production of IBS blocks. Lightweight foamed concrete's versatility, including its application in precast components like beams, slabs, and partition walls, combined with POFA, offers improved thermal insulation, fire resistance, and acoustic properties. These characteristics make it suitable for a wide range of construction applications, potentially reducing construction time and costs.

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## 4. CONCLUSION

This study confirms that POFA can effectively replace a significant portion of cement in the production of lightweight foamed concrete blocks, promoting sustainability in the construction industry. The optimised 15% POFA mixture offers an excellent balance of reduced weight and enhanced mechanical properties. Future research should focus on long-term durability and the scalability of using POFA in industrial applications to fully realise its benefits in sustainable construction.

## 5. ACKNOWLEDGMENT

The authors would like to express their gratitude to Universiti Teknologi Mara (UiTM) Seri Iskandar, Perak branch for the support provided for this study. Additionally, thanks are extended to all those who participated in conducting the experiments at the UiTM Perak laboratory.

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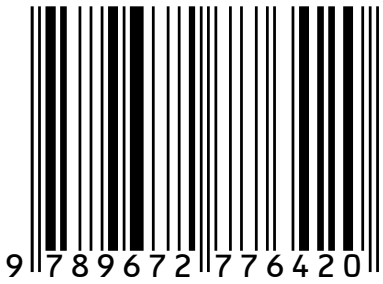


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