A comparison study of the fresh and hardened properties of normal weight and lightweight aggregate concretes

Payam Shafigh, Lee Jin Chai, Hilmi Bin Mahmud, Mohammad A. Nomeli

www.elsevier.com/locate/jobe

PII: S2352-7102(17)30483-7
DOI: https://doi.org/10.1016/j.jobe.2017.11.025
Reference: JOBE372

To appear in: *Journal of Building Engineering*

Received date: 16 August 2017
Revised date: 13 November 2017
Accepted date: 29 November 2017

Cite this article as: Payam Shafigh, Lee Jin Chai, Hilmi Bin Mahmud and Mohammad A. Nomeli, A comparison study of the fresh and hardened properties of normal weight and lightweight aggregate concretes, *Journal of Building Engineering,* https://doi.org/10.1016/j.jobe.2017.11.025

A comparison study of the fresh and hardened properties of normal weight and lightweight aggregate concretes

Payam Shafigh[a, b *], Lee Jin Chai[c], Hilmi Bin Mahmud[c], Mohammad A. Nomeli[d]

[a] Department of Building Surveying, Faculty of Built Environment, University of Malaya, 50603 Kuala Lumpur, Malaysia
[b]Center for Building, Construction & Tropical Architecture (BuCTA), Faculty of Built Environment, University of Malaya, 50603 Kuala Lumpur, Malaysia
[c]Department of Civil Engineering, Faculty of Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia
[d]Department of Mechanical Engineering, University of Maryland, College Park MD 20742, USA
* Email: pshafigh@gmail.com, Tel: +60172437383, Fax: +60379675713

Abstract

This study compares the engineering properties of normal weight concrete with those of concrete with two types of lightweight aggregates, namely, oil-palm-boiler-clinker (OPBC) concrete and lightweight expanded clay aggregate (LECA) concrete. OPBC is a porous solid waste from the palm oil industry, while LECA is an artificial and impenetrable material. The conventional coarse aggregates in a high-strength normal weight concrete were replaced by each of these lightweight aggregates, and the effect of such substitution on the fresh and hardened properties of the concrete was studied. The test results revealed that the OPBC concrete outperforms the LECA concrete in terms of workability, mechanical properties, and specific strength. The LECA concrete achieved its ceiling strength in 7 days, while the OPBC concrete still had strength gain by time. The LECA concrete demonstrated a greater drying shrinkage than both the normal weight and OPBC lightweight concretes between 14 days and 90 days. The use of OPBC must therefore be promoted to produce a cleaner and greener concrete that can benefit the construction and agricultural industries.

Keyword: Lightweight aggregate; Lightweight aggregate concrete; Mechanical properties; Specific strength; Ceiling strength, Drying shrinkage

1. Introduction

Using structural lightweight concrete instead of normal weight concrete can improve the structural efficiency of buildings. Lightweight concrete shows a better thermal performance than normal concrete, and its application may significantly reduce the energy consumption in buildings. Real et al. (2016) argued that the application of structural lightweight aggregate concrete in buildings located in European countries could reduce heating energy consumption by 15% compared with normal weight concrete. To achieve sustainable development, researchers have attempted to identify the waste or byproduct materials that can replace the materials in lightweight concrete without consuming limited natural resources (Pelisser et al. 2011). Tropical regions and countries with palm oil industries produce many types of waste that can be used as lightweight aggregates or replacements to cement, which in turn can aid in the development of sustainable structural