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A new vision to apply light-weight aggregate composite concretes via development of self-compacting concrete

***Yousef Aburas* ***

Department of Civil Engineering, School of Science and Technology, The University of Georgia, P. O. Box: 0171, Tbilisi, Georgia

COMMENTARY

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Abstract

This study explores innovative approaches to the application of light-weight aggregate composite concretes through the development of self-compacting concrete (SCC). It highlights the benefits of integrating lightweight aggregates in SCC formulations, which enhance mechanical properties and reduce structural weight. The discussion emphasizes the potential for improved sustainability and efficiency in construction practices, paving the way for future advancements in concrete technology.

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1. Introduction

Lightweight aggregate concretes (LWAC) are innovative building materials that use low specific gravity aggregates to reduce the overall density of concrete and improve its performance [1]. These concretes are particularly valuable in construction applications where weight reduction is crucial, such as high-rise buildings and infrastructure projects [2]. The materials used in the production of LWAC include expanded fly ash, clay, shale, pumice, and diatomaceous earth [3]. Therefore, it has a considerably lower bulk density than concrete. In addition, different types of aggregates can be used to design concretes of different densities and strengths [4]. Lightweight aggregates not only reduce dead loads of structures, but also improve thermal and acoustic insulation. Hence, LWAC is often selected for applications requiring enhanced energy efficiency and soundproofing [5]. A significant transformation is taking place in the construction industry due to the light-weight aggregate composite concretes through development of self-compacting concrete (SCC) [6]. A significant advancement is the development of self-compacting lightweight aggregate concrete (LWSCC), which provides a number of advantages over traditional concrete formulations [7]. The objective of this innovative combination is to enhance the performance, efficiency, and sustainability of concrete structures.

2. The advantages of self-compacting lightweight aggregate concrete

In self-compacting concrete, the material flows and fills forms without any mechanical vibration. A property such as this is especially useful in complex formwork and densely reinforced structures where conventional concrete may be unable to achieve uniformity [8]. In addition to maintaining self-compacting properties, LWSCC reduces the overall density of the concrete by using lightweight aggregates like pumice, scoria, or expanded clay [9]. Consequently, the material is easier to work with and minimizes structural dead loads. Self-compacting concrete can be designed for energy-efficient design due to its thermal and acoustic insulation properties, which are enhanced by lightweight aggregates. Additionally, LWSCC has improved durability characteristics, such as reduced permeability and crack resistance [10].

3. Innovations in mix design and applications LWSCC

Recent research has examined mix designs for LWSCC to maximize mechanical properties while maintaining workability. Research has shown that aggregate types and proportions have a significant impact on the performance of LWSCC [11-13]. There are several lightweight aggregates (LWAs) that can be used in its development, such as artificial lightweight aggregates (ALWA), light expanded clay aggregates (LECAs), pumice, and vermiculites [11, 14]. As an example, saturated pumice aggregates improve flowability and cohesiveness in the mix, making it self-compacting without segregation. Furthermore, advances in admixture technology have led to the development of chemical additives that enhance LWSCC's rheological properties [11]. The additives help the material flow into intricate shapes and around reinforcement bars while maintaining a stable mix. The use of lightweight aggregate composite concretes in modern construction projects is

* *Corresponding author: Yousef Aburas. E-mail: yousefaburas@ug.edu.ge*
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particularly relevant because of the self-compacting technology. In high-rise buildings, precast elements, and infrastructure projects such as bridges and tunnels, LWSCC reduces weight and enhances performance. Addition to speeding up construction time, eliminating vibration during placement reduces labor costs associated with traditional concrete methods [15]. With advance advancements in these materials and techniques, LWSCC will have an essential role to play in creating a sustainable, durable, and energy-efficient infrastructure in the future.

4. Conclusion

In terms of construction technology, applying lightweight aggregate composite concretes through the development of self-compacting concrete represents a significant advancement. LWSCC's lightweight aggregates combine with the advantages of self-compacting mixtures to provide a sustainable solution suitable for contemporary construction practices.

Author contributions

Yousef Aburas: Writing—Original Draft Preparation, Investigation, Resources, Writing—Review and Editing.

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Conflict of interest

The author declares no conflict of interest.

Data availability

No data is available.

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