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# The Effect of Styrofoam Artificial Lightweight Aggregate (ALWA) on Compressive Strength of Self Compacting Concrete (SCC)

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**Abstract**

Self-compacting concrete (SCC) is a fresh concrete that is able to flow and fill up the formwork by itself without the need of a vibrator to compact it. One of the reasons that causes the damage of a building structure during an earthquake is the heavy weight of its structural members which are from the high density of the material used such concrete material. Lightweight aggregate is one of the solutions to reduce the weight of the structure. Therefore, the SCC using the artificial lightweight aggregate (ALWA) is one of the solutions to reduce the self-weight (dead load) of a structure. This research was conducted to investigate the impact of the use of ALWA in conventional concrete and SCC in terms of its compressive strength and modulus of elasticity. To study the impact of the use of ALWA in SCC, several variation of percentage of ALWA as a substitution to the natural coarse aggregate was examined. The proportions of ALWA as a replacement to the coarse aggregate were 0%, 15%, 50%, and 100%. The test specimens were the cylindrical concrete of 200 mm in height and 100 mm in diameter for both compressive strength and modulus of elasticity tests. The results of the compressive strength test indicated that the higher the percentage of ALWA used in SCC, the lower the compressive strength of the concrete. The addition of ALWA as a substitution to the natural coarse aggregate to conventional concrete and SCC was found optimum at 15% replacement with the compressive strength of conventional concrete and SCC of 21.13 and 28.33 MPa, respectively. Whereas, the modulus of elasticity of the conventional concrete and SCC were found to be 20,843.99 and 23,717.77 MPa, respectively.

*Keywords:* Artificial Lightweight Aggregate; Compressive Strength; Modulus of Elasticity; Self-Compacting Concrete; Styrofoam.

## 1. Introduction

Concrete is one of the options for structural materials and its use is the most popular in the construction among others [1-3]. However, its heavy weight brings another issue to the buildings particularly in terms of construction and its vulnerability to earthquake disaster. An earthquake is one of the natural disasters that can cause severe damage to the building structures [4-6]. The earthquake force received by the building structure is directly proportional to the weight of the corresponding building. Lightweight concrete is used as an alternative to reduce the self-weight of the building structure such that it can mitigate the damage of the building structures due to the severe earthquakes. Therefore, the need of lightweight materials becomes increasingly popular and required urgently for various applications in the modern construction technology for structural members [7, 8]. This is due to the various advantages that can be obtained from the use of lightweight concrete material, such as smaller density of concrete resulting in lower self-weight of the structural members [9, 10]. To be categorized as lightweight concrete, its density should be less than 1840 kg/m$^3$ [11].

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