UNIVERSITI TEKNOLOGI MARA

TECHNICAL VIABILITY STUDY OF STEEL SLAG AS NON - CONVENTIONAL MATERIAL IN CONCRETE

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Although recycling of waste material has started since the last few decades, recycling as a means of sustainable use of Non-Conventional material did not actually start until fairly recently. Recycling of industrial waste and by-product material which is an environmentally sensitive problem faced by waste manager throughout the world is no exception. Specifically steelmaking operations are concerned by this problem because of the generation of a huge quantity of by - products such as Electric Arc Furnace Slag (EAFS). Basically, there are two reasons to the rationale underlying the usage of slag as a source of aggregate; the need to conserve natural resources and the need to manage waste amicably. However, to make the feasible acceptance of slag as aggregate in concrete, its strength, deformation and durability must also be assured. This research attempts to provide that assurance by conducting a comprehensive investigation on the strength, deformation and durability performance. This study is divided into four (4) main phases: (i) chemical and physical properties of slag and its suitability as aggregate for concrete production (ii) design of mix proportions of SSA using replacement level of 0%, 10%, 50% and 100%. Six (6) series of concrete specimen were cast. The series refer to the difference of w/c ratios between the ranges 0.47 – 0.7. The specimens were tested from 3 days until 365 days (iii) the engineering properties considered include compressive, tensile and flexural strength, modulus of elasticity and drying shrinkage. These properties are important in evaluating the performances of the SSA concrete compared to the corresponding NA concrete (iv) in order to access the durability performance of SSA concrete, resistance to carbonation, sulphate attack and gas permeability were conducted. Gradation of the aggregates shows that the slag aggregates is suitable for concrete and complied to existing BS EN 12620:2002. Tests on the aggregate have shown that the resistance to mechanical action such as the impact and crushing value for slag aggregate is lower but higher in specific gravity and water absorption capacity than the natural aggregates. From the strength point of view with various w/c, the slag aggregate concrete compared well with the natural aggregate concrete. The mechanical properties steel slag aggregate concrete increased with the proportion of coarse aggregate. The results indicated that the higher concrete strength was obtained for the mixtures possessed a percentage of 100% SSA as a replacement of the coarse aggregate for all various w/c used. The static modulus of elasticity of the SSA concrete is found to be higher than NA concrete which is the higher the w/c ratio, the lower the static modulus of elasticity. With respect to deformation, SSA concrete produces lower drying shrinkage, at low w/c ratio. The drying shrinkage of the concrete mixtures incorporating with 10 and 100% SSA were approximately 33% and 51% less than of NA concrete respectively. The SSA concrete exhibited good durability performance compared to NA concrete. Using regression analysis, the correlation between the compressive and other mechanical properties and durability performance of control NA and SSA concrete have also been established.

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