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FACULTY OF ENGINEERING

DEPARTMENT OF WATER RESOURCES ENGINEERING

WATER RESOURCES ENGINEERING PROGRAMME

PROJECT TITLE: INVESTIGATING THE EFFECT OF PARTIAL REPLACEMENT OF STEEL SLAG AS A COARSE AGGREGATE IN PERVIOUS CONCRETE.

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This report is submitted to the department of water resources and mining engineering as a partial fulfillment for a ward of a bachelor's degree in water resources engineering at Busitema university

ABSTRACT.

Background: The need to improve the manufacture composition and sustainability of porous concrete with a major construction material that is environmentally friendly especially construction application of relatively light loads led to this research. Steel slag is an alternative that can be to replace the natural aggregates and it is a by-product of steel manufacturing and approximately 160 kg of steel slag is generated per ton of steel produced. Since steel slag is a waste material it helps in preserving the natural resources and reducing solid waste disposal making it environmentally friendly.

Methods: Steel slag was used to partially replace natural coarse aggregates. Tests like Gradation of the aggregates, bulk density, specific gravity, Aggregate Crushing value, Aggregate impact Value and flakiness index to determine the physical and chemical properties of the aggregates. Steel slags' application as an aggregate that has great strength and permeability was demonstrated using CCD of Response Surface Methodology and tests conducted using the obtained mix ratios. The effect on compressive strength and permeability was obtained from plots of varying the steel slag and cement percentages. Using CCD, experiments were carried out and the response modeled using quadratic equations as functions of variables. A cost effectiveness comparison was done to determine if it was less costly to use steel slag as a partial replacement of coarse aggregates.

Results: The optimum values of the variables were found to be 25.99079(Steel slag) and 16%(cement) with responses of compressive strength and permeability. Using CCD, quadratic equations were obtained to demonstrate the relationship between the cement and steel slag aggregates.

Conclusions: It was expected that the increase of steel slag aggregates would increase the strength of pervious concrete. From the tests, Steel slag can be used adequately as a coarse aggregate up to about 25% (with a cement percentage of 16%) above which, the compressive strength reduces. The replacement proved to have some environmental benefits and would be an economical or cost-effective technique in concreting in the future. In this project, solid waste was utilized and there was no hazardous effect on strength.

key words: Steel slag, Pervious concrete, Compressive strength, permeability, Economic, Environmental.

DEDICATION

I dedicate this report to my beloved parents in appreciation for their selfless care and support provided to me throughout my studies, and for the spirit of hard work, courage and determination instilled into me, which have indeed made me what I am today.

DECLARATION

I KADONDI VIVIAN, hereby declare to the best of my knowledge, that this project proposal is an outcome of my efforts and that it has not been presented to any institution of learning for an academic award.

Signature: .....

Date: 12./01../...23

APPROVAL

This final research report has been submitted to the Faculty of Engineering for examination with approval of my supervisor.

Supervisor

MR. TIGALANA DAN

Signature..... Date 12/01/2023

MR. TUMUSIIME GODIAS

Signature..... Date 12/01/2023

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NEMA	National Environmental Management Authority
ACV	Aggregate Crush Value
AIV	Aggregate Impact Value
LAA	Los Angeles Abrasion
OPC	Ordinary Portland cement
KCCA	Kampala Capital City Authority
NC	Normal concrete
w/c	water cement ratio
A/c	Aggregate Cement ratio
Kg	kilogram
MoWT	Ministry of Works and Transport
ASTM	American Standards for Testing Material
CCD	Central Composite Design
DOE	Design of Experiments
CA	Coarse Aggregates
FA	Fine Aggregates

CHAPTER 1

1.0. INTRODUCTION.

This chapter presents the background information of the project with details on the use of steel slag aggregates to replace coarse aggregates and what has been done to improve its applicability. It also explains various alternatives available and also presents the problem statement, the objectives to be fulfilled and the scope of the study with the justification.

1.1. BACKGROUND

Concrete is a heterogeneous mixture that consists of the following components; cementitious material, aggregate and water (Tantawi, 2011). There are two types of concrete; conventional concrete and porous concrete. Porous concrete is concrete with a high void content to allow water to penetrate (Vanchai & Chindaprasirt, 2020). Porous concrete consists of coarse aggregate, cement paste with fewer fines or no fines (Rajasekhar & Spandana, 2016).

The optimization of concrete can be achieved by means of studying the ingredients of concrete mixes with the aim of maximizing the performance of concrete in both fresh and hardened state while keeping a low cost of production and limiting the pollutants released in the air (Ghasemi, 2017). The aggregate and binder characteristics control the bond between aggregates and paste, for most properties, concrete performance is primarily controlled by the level of this bonding (Bentz & Jones, 2018)

As a result, researchers have been continuously working with the ways of optimizing mix design recipes. The role of the constitutes in fresh concrete is fundamental to the production of high-quality concrete at fresh state during hardening and as a hardened structural material (Ghasemi, 2017). Aggregates are an important constitute in concrete, since it occupies 60% to 70% of the concrete volume (Portland Cement Association) and strongly influences the concrete's freshly mixed and hardened properties.

Aggregates used in concrete can be natural or synthetic. Steel slag is a synthetic material that is an industrial by product obtained from steel manufacturing industries and is obtained in large quantities during steelmaking operations (Baoguo & Jinping, 2014). Recent research has shown that concrete with steel slag has slightly higher compressive strength, flexural strength, splitting tensile strength and modulus of elasticity as compared to concrete with normal aggregates (Xin, Zhag, Tianyi, & Pan, 2016). Since steel slag is a waste material it helps in preserving the natural resources and reducing solid waste disposal making it environmentally friendly. The physical properties of steel slag aggregate are better than those of aggregate (Maslehuddin, Sharif, Shameem, Ibrahim, & Barry, 2010) due to the high density of steel slag (Biskri, Achoura, Chelghoum, & Mouret, 2017)

The coarse aggregate type can have a significant impact on properties and performance of concrete. This impact depends on the microstructure of the interfacial transition zone that is formed between coarse aggregates and the surrounding mortar (Kamali, Keinde, & Bernard, 2014) and particularly on the level of bond established between these two. This bond can be influenced by both physical (roughness, shape, angularity) and chemical (reactivity) attributes of the aggregates (Tasong, Lynsdale, & Cripps, 2015). The physical and mineralogical properties of concrete that must be known before mixing concrete to obtain a desirable mixture

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