DERIVING OPTIMUM MIX DESIGNS FOR HIGH – STRENGTH CONCRETE USING GENETIC ALGORITHMS

Andres Winston ORETA
Professor
De La Salle University
Manila, Philippines
andyoreta@yahoo.com

Alden Paul BALILI
Professor
De La Salle University
Manila, Philippines
alden.balili@gmail.com

Bertrand TEODOSIO
Civil Engineering Graduate
De La Salle University
Manila, Philippines
bertrand.teodosio@hotmail.com

Iris Mae MALABATUAN
Civil Engineering Graduate
De La Salle University
Manila, Philippines
iris.malabatuan@gmail.com

Analyn YEE CONCEPCION
Civil Engineering Graduate
De La Salle University
Manila, Philippines
analyn710@gmail.com

Summary

High-strength concrete (HSC) is a highly complex and evolving construction material. Careful selection of constituent materials must be employed to successfully proportion HSC mixtures. While there are codes like ACI and ASTM which guide concrete proportioning, batching companies perform trial and error to produce a number of trial mixes depending on a required strength and slump. This method, however, is costly, time consuming and sometimes uneconomical and wasteful. Hence, genetic algorithms (GA) was explored in deriving optimum HSC mix designs using data collected from a batching company. Verification was implemented through in-situ adjustments and compression tests resulted to be applicable in actual practice that suggested a reduction in the number of trial mixtures and lesser incurred overall material cost of HSC.

Keywords: High – Strength Concrete, Genetic Algorithms, Optimum Mix Design, Compressive Strength, Concrete Workability.

1. Introduction

In a developing country, like the Philippines, constructing massive structures is a flourishing industry. Development is somehow related to the construction of infrastructures that will reflect the thriving economy of a country. Coinciding with development is a great demand for abundant amount of concrete for functional and safe yet not too pricey structures.

Many factors affect the concrete mix design performance, and each constituent's effect on strength development is so complicated that it is close to impossible to formulate mathematical models to relate the behavior of HSC's components; due to its complexity, considering the fact that HSC mix design involves more materials than conventional concrete like superplasticizer, silica fume, fly ash, and other supplementary cementitious materials that are supposed to replace cement as a material. Hence, through the use of genetic algorithm, a program for finding an optimum HSC mix could be developed which will simplify the determination of a better HSC mixture. GA could aid in developing an optimum mix proportion design which could in turn, pave way for an innovation in the Philippine civil engineering study on high-strength concrete by minimizing the overall concrete wastage incurred in design mixes batched through the trial and error method.

Moreover, in view of the fact that in most cases, cost of HSC is a concern in finding the optimal solution for the design mix, cost of the constituent materials comprising HSC is another parameter that the study aims to minimize by comparing the overall material cost of the optimum HSC mixes derived by the proponents of this research with the trial mixes provided by a company which granted data to be used for this study. Applying genetic algorithms on HSC in a local context, specifically, in the actual methodology of concrete batching and mixing will be advantageous to the local batching company.

https://doi.org/10.2749/222137912805112716