



A Quantitative Approach to Prioritize Sustainable Concrete

L. Sudheer Reddy ^a, A. Suchith Reddy ^b, S. Sunil Pratap Reddy ^{a*}

^a Department of Civil Engineering, Kakatiya Institute of Technology & Science Warangal (KITSW), Telangana, India.

^b Department of Civil Engineering, National Institute of Technology Warangal (NITW), Telangana, India.

Received 21 July 2019; Accepted 29 October 2019

Abstract

Cement industry consumes high energy and produces major emissions to the environment. In order to reduce the effects (environmental impact, energy, and resources) caused by conventional materials, various by-products and pozzolonic material are used to achieve sustainable concrete. Assessing the concrete performance based on multiple conflicting attributes is decisive and compelling. It is difficult to choose an alternative among the Supplementary Cementitious Materials (SCM) considering a set of quantitative performance attributes. Hence, the present study utilizes the theories of decision making to prioritize an alternative environmentally and technologically. The purpose of the present study is to observe the sustainable performance of five different concretes made of OPC, Fly ash, GGBS, Metakaolin and Composite Cement for a particular grade of concrete. The study has considered workability, strength attribute (compressive strength, split tensile and flexural strength) and durability attribute (Sorptivity and RCPT) at their respective optimum replacements. To prioritize an alternative material considering quantitative attributes, Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is utilized. From the results, it is observed that considering all attributes, flyash based concrete has higher performance and is prioritized among others. The developed approach facilitates the decision-makers in the selection of a sustainable alternative.

Keywords: Sustainable Concrete; Supplementary Cementitious Material; Multi-Criteria Decision Method; Environment; TOPSIS.

1. Introduction

In developing countries like India, the population is increasing at an asymptotic rate, thus there is a demand for all types of infrastructure facilities. The building industry is growing at a faster rate by consuming the major natural resources resulting in higher carbon footprint [1]. India is the fourth-largest emitter of CO₂, where the major contributor of it is the energy sector with the construction industry being a subset of it [2]. Thus, there is an urgent need to shift our thoughts towards sustainability. To attain sustainability in the construction industry, materials play a crucial part. Selection of suitable material which serves the purpose of the application without degrading the environment leads to sustainable construction. Currently, the construction industry is utilizing industrial by-products and waste materials to decrease the potential impact on natural/non-renewable resources [3]. Choosing appropriate material at the design stage will facilitate to reduce the impacts on the environment [4]. Selection of suitable sustainable material for construction will minimize the impacts, energy consumption and waste production. This will also increase the potential utility for future generations [5]. Therefore, by implementing the principles of sustainability in the construction industry by neglecting conventional practices will certainly achieve an ecological balance between future and present requirements [6].

* Corresponding author: sunilpratap@yahoo.com



<http://dx.doi.org/10.28991/cej-2019-03091434>



© 2019 by the authors. Licensee C.E.J, Tehran, Iran. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).