Optimization of concrete mix proportioning using a flatted simplex-centroid mixture design and neural networks

葉怡成
Information Management
Computer Science and Informatics
icyeh@chu.edu.tw

Abstract

The primary objective of this research was to combine three technologies, namely design of experiments (DOE), artificial neural network (ANN), and mathematical programming (MP), into an integrated methodology for mixing concrete containing SP, fly ash, and slag, consistent with desirable structural grade concrete properties. The function of DOE and ANN is to reduce the number of test mixes and specimens without sacrificing the accuracy of evaluating the effects and the interactions of variations of the components on workability and compressive strength. The function of the MP is to optimize the mixture to lower the cost while keeping the concrete to satisfy required properties. The scope of the research was limited to concrete with compressive strengths 25, 32.5, 40, 47.5, and 55 MPa, and workability 5, 10, 15, 20, 25 cm in slump; therefore, there were 55=25 concrete mixtures. The methodology proved to be applicable for concrete mixes with the above-mentioned wide range of strength and workability. It was also found that (1) the early strength requirement played the dominant role in low and medium strength concrete, while the late strength requirement played the dominant role in high strength concrete, and (2) the workability constraint played a critical role in all concrete except for concrete with low workability.

Keyword：mixture, concrete, optimization, design of experiments, artificial neural networks, mathematical programming.