

Analysis of strength of concrete using design of experiments and neural networks

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Abstract

This paper investigates the potential of using design of experiments (DOE) and neural networks to determine the effect of fly ash replacements, from 0 to 50%, on the early and late compressive strength, from 3- to 56-day, of low- and high-strength concrete, at water-cementitious material ratio in the range of 0.3 to 0.7. Research reported in this paper shows the following conclusions. (1) Using a simplex-centroid mixture experiment design, a much smaller number of experiments need be performed to obtain meaningful data. (2) High correlations between the compressive strength and the component composition of concrete can be developed using the generalization capabilities of the neural networks. (3) Analyses of variance to test the effects of the variables and their interactions on concrete strength can be performed. (4) The strength ratio, which means the percentage of strength of concrete containing fly ash to strength of concrete without fly ash (pure cement concrete) based on the same w/b and the same age, is significantly reduced as the fly ash replacement increases, somewhat reduced as the water-binder ratio decreases, and much significantly reduced as the age decreases. (5) The higher fly ash content mixes yielded lower strength ratios throughout, the difference being greater at early age and low water-binder ratio.

Keyword : concrete, fly ash, strength, neural networks.