

Drying shrinkage behavior of mortars made with ternary blends

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Abstract

In this paper, shrinkage behavior of mortar mixes made with various ternary blends is investigated. The ternary blends consisting of different combinations of Portland or blended cement, ground granulated blast furnace slag (GGBFS), fly ash (Type C and F) and/or silica fume are considered. The contents of GGBFS, fly ash and silica fume range 15-35%, 13-30%, and 3-10%, respectively. Mortar bars are made with the ternary blends and subjected to a drying condition ($T=73 \pm 3$ °F and $RH=50 \pm 4\%$) after a standard curing for 28-days. Free shrinkage of the mortar bars is measured up to 28 days. Based on the test results, a response surface analysis is performed to examine the effects of blend proportions on shrinkage behavior of the mortars. A statistical model is also developed for predicting the mortar shrinkage behavior. To validate this newly developed model, shrinkage strains of an independent group of mortar mixes are measured, and the measured values are compared with the predicted shrinkage values. The results indicate that among the three supplementary cementitious materials in the ternary blends studied, GGBFS shows a pre-dominant effect on mortar shrinkage. The contribution of C-fly ash to the mortar free shrinkage is slightly less than that of GGBFS. Increase in silica fume content slightly increases free shrinkage, while increase in F-fly ash content slightly decreases free shrinkage of the mortar. There is a good correlation between the measured shrinkage strain and the strain predicted from the shrinkage model developed from the response surface analysis.

Keywords: ternary blend, supplementary cementitious materials, shrinkage

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