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Improving Flexural Performance of Ultra-High-Performance Concrete by Rheology Control of Suspending Mortar

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Abstract

This study develops a rheology control method to improve steel fiber distribution and flexural performance of ultra-high-performance concrete (UHPC) by adjusting the rheological properties of the suspending mortar of UHPC before steel fibers are added. Correlations among the plastic viscosity of the suspending mortar, the resulting steel fiber distribution, and flexural properties of UHPC are established. This was done by changing the dosage of viscosity modified admixture (VMA) for investigated UHPC mixtures. The optimal plastic viscosity of the suspending mortar that allows for the optimized fiber distribution and flexural performance of UHPC is determined. The plastic viscosity is correlated with the mini V-funnel flow time, which provides a simple alternative to evaluate the plastic viscosity. For a UHPC mixture with 2% micro steel fibers, by volume, the optimal mini V-funnel flow time of suspending mortar was determined to be 46 ± 2 s, which corresponded to the optimal plastic viscosity (53 ± 3 Pa·s) that ensures the greatest fiber dispersion uniformity and flexural performance of UHPC. However, increasing the VMA dosage retarded the hydration kinetics and reduced the degree of hydration, compressive strength, and the bond properties of the fiber-matrix interface of UHPC.

Keywords

Fiber distribution; Flexural properties; Mini-V funnel; Plastic viscosity; Ultra-high-performance concrete (UHPC)

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