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Design and Implementation of Ultra-High Performance Fiber-Reinforced Concrete Mixtures

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Abstract. Advanced cementitious and fibrous technologies are used for manufacturing ultra-high-performance concrete (UHPC), which has remarkable strength and endurance. Its dense microstructure minimizes porosity, effectively preventing the penetration of ingressive materials. The maximum compressive and tensile strength was achieved by Mix 7, which contained 30% SF and 15% FA, proving the value of a balanced SCM ratio. On the other hand, because of the delayed pozzolanic reaction, an excessive amount of FA, as observed in Mixes 3 and 6 (52% FA), had a negative impact on early-age strength. Similarly, mix 10's compressive strength decreased when the SF content was increased to 52%, highlighting the significance of preserving an ideal SCM balance. Furthermore, the lowest strength values were observed by Mixes 9, 11, and 12, whose cement concentration was less than 300 kg/m³. This confirms that UHPC requires a minimum cement threshold.

Keywords: High-performance concrete, Fly Ash, Silica Fume, Pozzolanic materials.