

ABSTRACT

The performance of Ultra-High-Performance Concrete (UHPC) structural elements is significantly influenced by the orientation and distribution of steel fibers, which are in turn governed by casting procedures and placement techniques. Despite the growing adoption of UHPC in bridge and infrastructure applications, there remains a lack of standardized casting methodologies that ensure consistent mechanical performance without reliance on full-scale mock-up testing.

This study investigates the influence of casting procedures on fiber orientation and the resulting mechanical behavior of UHPC structural elements. A comprehensive experimental program was conducted involving the fabrication of representative structural specimens using multiple practical casting and placement techniques. The entire fabrication process, including material mixing, placement, and curing, was systematically monitored and documented.

Fiber orientation characteristics were evaluated and correlated with mechanical performance through experimental testing, including uniaxial tensile response and structural behavior assessments. The results demonstrate that casting methodology significantly affects fiber alignment, which in turn governs tensile strength, ductility, and overall structural performance. Variations in placement techniques were found to produce measurable differences in fiber orientation distributions and corresponding mechanical properties.

Based on the experimental findings, this research establishes a framework for optimizing UHPC casting procedures with a defined level of confidence in achieving target mechanical properties. The outcomes contribute to reducing the need for project-specific mock-up testing and support the reliable implementation of UHPC design provisions for structural applications, particularly within Florida transportation infrastructure.