

# Research in Progress

## Ultra-High Performance Concrete Reinforced with Multi-Scale Hybrid Fibers and Its Durability-Related Properties

### Research Need

MassDOT is seeking to improve the quality and durability of fiber-reinforced concrete (FRC) and ultra-high performance concrete (UHPC) for longevity and constructability of new structures and repair of existing structures. There exist critical gaps in understanding the efficiency of mixture design and fibers on concrete performance, especially the mechanical and durability-related properties. A better understanding of FRC and UHPC will promote the development and applications of high-quality concrete to satisfy the performance expectation of future transportation infrastructure.

### Goals/Objectives

The overall research objective of this project is to develop novel, non-proprietary, FRC and UHPC mixtures to identify and maximize the roles of fibers and additives in enhancing mechanical and durability-related properties, and to promote the widespread use of FRC and UHPC in transportation infrastructure. The project includes seven primary research tasks including literature review, development of a qualified construction materials list, optimization of mixture design, physical, mechanical, and durability-related property evaluations, large scale batching, mockup and field tests to investigate merits and barriers impacting successful applications of FRC and UHPC in the transportation infrastructure. This project will benefit the Standard Specification Development for construction materials by improving quality and extending service life of critical infrastructure related to public safety.

### Project Information

This project is being conducted as part of the Massachusetts Department of Transportation (MassDOT) Research Program with funding from Federal Highway Administration (FHWA) State Planning and Research (SPR) funds.

#### Principal Investigators:

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#### Performing Organizations:

University of Massachusetts, Lowell  
University of Massachusetts, Amherst

#### Project Champion:

Richard Mulcahy, MassDOT

#### Project Start Date:

September 2021

#### Expected Project Completion Date:

October 2023

### Methodology

The experimental plan for this project includes:

1. Conduct a thorough literature review on materials, testing standards and applications of FRC and UHPC;
2. Establish an experimentation-based database for qualified fibers selection and screening;
3. Optimize mixture design for FRC and UHPC based on different materials and mixing proportions;
4. Develop mixtures for large-scale batching and field applications;
5. Conduct laboratory, mockup and field tests to evaluate the performance of FRC and UHPC.

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