Research in Progress

Alternative Constituent Materials for Use in Low-Carbon Cement Concrete – Part II

Research Need

MassDOT needs performance-based guidance to implement low-carbon concrete while maintaining durability, safety, and service life under Massachusetts exposure conditions, including deicing salts, freeze–thaw cycling.

Goals/Objectives

The objective of this project is to evaluate emerging binders, admixtures, and alternative constituent materials as lower-carbon alternatives to traditional cementitious systems for MassDOT highway concrete, while maintaining or improving constructability, strength, durability, and service life.
Key objectives include:
Review current practices, knowledge gaps, and implementation barriers for EBAs in highway concrete.
Characterize hydration, microstructure, and phase development in EBA-based cement systems.
Develop MassDOT-relevant concrete mixture designs incorporating EBAs and alternative materials.
Evaluate fresh, mechanical, and durability performance of the selected mixtures.
Validate promising mixtures through field-relevant mock-ups and support implementation guidance.

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.

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Project Start Date:
05/15/2026

Expected Project Completion Date:
04/14/2029

Methodology

The research team will develop, screen, and validate low-carbon concrete mixtures for MassDOT applications using laboratory testing and field-relevant mock-ups. Candidate systems will include various emerging cements and chemical mixtures. Fresh peMingjianrformance will be evaluated through slump, air content, workability retention, rheology, and placement. Hardened performance will be assessed through strength, resistivity/formation factor, chloride-resistance indicators, freeze–thaw and scaling performance as needed, and alkali-silica reaction mitigation. Microstructural testing will be used to explain underlying mechanisms. Results will be translated into recommended mixture designs, QC checkpoints, and draft specification language for MassDOT implementation.

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