# Development of Novel Ultra-High Performance Engineered Cementitious Composites (UHP-ECC) for Durable and Resilient Transportation Infrastructure Dataset

**Dataset available at:** https://doi.org/10.5281/zenodo.6430650

(This dataset supports report **Development of Novel Ultra-High Performance Engineered Cementitious Composites (UHP-ECC) for Durable and Resilient Transportation Infrastructure**)

This U.S. Department of Transportation-funded dataset is preserved by the National Center for Sustainable Transportation (NCST) in the Zenodo Repository (https://zenodo.org/), and is available at https://doi.org/10.5281/zenodo.6430650

The related final report **Development of Novel Ultra-High Performance Engineered Cementitious Composites (UHP-ECC) for Durable and Resilient Transportation Infrastructure**, is available from the National Transportation Library's Digital Repository at https://rosap.ntl.bts.gov/view/dot/61700.

**Metadata from the Zenodo Repository record:**

Title: Development of Novel Ultra-High Performance Engineered Cementitious Composites (UHP-ECC) for Durable and Resilient Transportation Infrastructure

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Description: The objective of this study was to develop novel UHP-ECC materials utilizing readily available ingredients in Region 6 for the construction and repair of transportation infrastructure. Phase one of this study focused on the development of ultra-high strength cementitious matrices by evaluating the effects of ingredient selection and mixture proportioning on the materials' compressive strength. Variables evaluated included the mass ratios of silica fume to fly ash (SF/FA), supplementary cementitious materials to cement (SCMs/C), and ordinary sand to microsilica sand (OS/MS). Phase two of the study focused on the development of UHP-ECC materials. To this end, based on the knowledge gained from phase one, two ultra-high strength cementitious matrices (one with and one without SF) were formulated and their fracture properties were evaluated through fracture toughness test. Furthermore, fiber-bridging properties of ultra-high-molecular-weight (UHMW) polyethylene (PE) fiber in the developed cementitious matrices were evaluated through single crack tensile test (SCTT). Four different composites were produced by reinforcing the selected cementitious matrices with 1.5 and 2 vol.% UHMW PE fiber. Fresh and hardened properties of the developed composites were assessed by means of flowability test, compressive strength test, uniaxial tensile test, and flexural performance test. Results from phase one showed that SF/FA had the most relevant effect on compressive strength, followed by SCMs/C, and OS/MS. Furthermore, increments in SF/FA produced improvements in strength, whereas increments in SCMs/C and OS/MS reduced strength. Experimental results from phase two indicated that the use of SF and the increase in fiber content generally had a negative effect on the fresh and hardened properties of the composites. These observations were credited to a worsening fiber distribution when using silica fume and/or increasing fiber content. Three UHP-ECC materials utilizing readily available ingredients were successfully developed (i.e., mixtures FA25-f1.5, FA25-f2, and FA20SF5-f2).

These materials simultaneously exhibited ultra-high compressive strength (>120 MPa) and ECC-like ductility (tensile strain capacity >2%). The average crack width for all mixtures ranged between 61-131 μm. Mixture FA25-f1.5, which displayed the best mechanical properties, exhibited a compressive strength of 133.1 MPa, flexural strength of 21.4 MPa, tensile strength of 10.3 MPa, tensile strain capacity of 4.3%, and an average crack width of 115.3 μm. Importantly, this mixture did not incorporate silica fume or microsilica sand and used low fiber content (i.e., 1.5 vol.%).

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**Dataset description:**
This dataset contains 1 file described below.

**Dataset 1.3.2022.xlsx:**
The .xlsx and .xls file types are Microsoft Excel files, which can be opened with Excel, and other free available software, such as OpenRefine.

**National Transportation Library (NTL) Curation Note:**
As this dataset is preserved in a repository outside U.S. DOT control, as allowed by the U.S. DOT's Public Access Plan (https://ntl.bts.gov/public-access) Section 7.4.2 Data, the NTL staff has performed ***NO*** additional curation actions on this dataset. NTL staff last accessed this dataset at https://doi.org/10.5281/zenodo.6430650 on 2022-05-27. If, in the future, you have trouble accessing this dataset at the host repository, please email NTLDataCurator@dot.gov describing your problem. NTL staff will do its best to assist you at that time.