Second International Interactive Symposium on Ultra-High Performance Concrete
Extended Abstract (no paper submission)

Key Learnings and Trends in UHPC Bridge Activities since 2016

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Bridges
Project Examples / Applications

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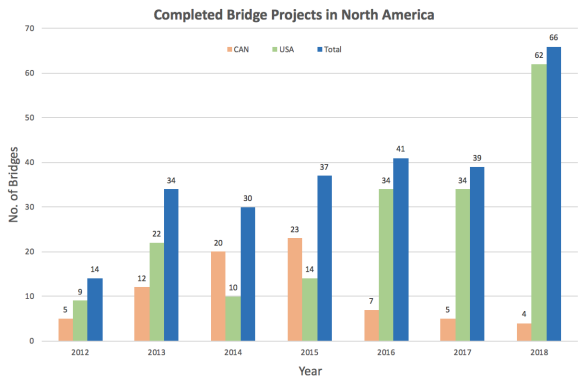
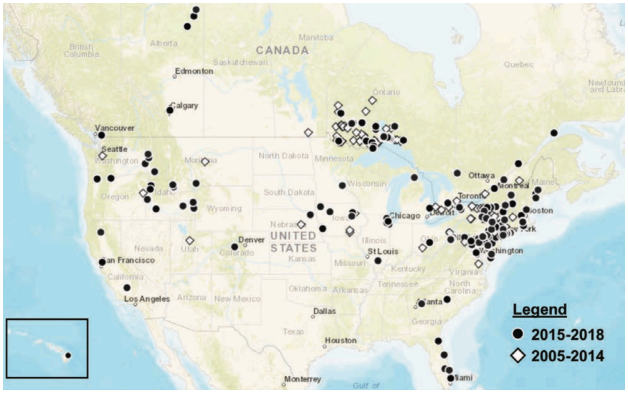
Extended Abstract

This presentation is meant to provide an overview of the ultra-high performance concrete (UHPC) bridge activities and projects since the First International Interactive Symposium on Ultra-High Performance Concrete which took place in Des Moines, Iowa in 2016. Since then, over 135 additional bridges have been constructed using UHPC bringing the total number of projects in North America to over 280 bridges.

The years prior to 2016 were largely dominated by precast deck panel projects with UHPC connections in the New York State region of the U.S. and by adjacent box beam projects with longitudinal UHPC connections in Northwestern Ontario. Since 2016, the Northeastern region of the U.S. (i.e. New York, New Jersey, Pennsylvania, Delaware, etc.) continue to regularly utilize UHPC on their projects. Additionally, there has been growing interest in the Western U.S. (i.e. California, Idaho, Colorado, Oregon) and the Southeast (i.e. Florida, Georgia, South Carolina). The figures below show the number of completed bridge projects with UHPC by year (left) and the locations of these projects (right).



Completed Bridge Projects: 2012-2018



Completed Bridge Projects: 2005-2018
(ref: FHWA-HRT-19-011; Fig. 35)

For a detailed list of completed UHPC bridge deployments in North America, visit FHWA's website at https://highways.dot.gov/bridges-and-structure/ultra-high-performance-concrete/deployments

The state of Idaho, in particular, has seen substantial activity since standardizing UHPC connections for two of their superstructure types (i.e. deck bulb-tees and solid/voided slab beams). The Idaho Transportation Department (ITD) has replaced over ten (10) bridge superstructures with UHPC since 2016, with more in the pipeline for 2019 and beyond. The Iowa DOT has also standardized UHPC connections for their adjacent box beam structures and is letting an 8 to 14 bridge replacement package in 2019.

While precast deck panels and adjacent box beams are still popular applications, there has been a notable increase in other superstructure types such as deck bulb tees, next beams, voided slabs, and prefabricated bridge units (PBUs) with longitudinal UHPC connections. These systems have become popular, particularly for shorter span structures, as a means to rapidly replace existing deteriorated superstructures using the Accelerated Bridge Construction (ABC) methodology.

In conjunction with these ABC systems has been an increasing demand for high early-strength UHPC mix designs for closure pour connections. Accelerated UHPCs (e.g. Ductal® JS1212) can attain design compressive strength (typically 14 ksi) in 24-36 hours compared to non-accelerated UHPCs (e.g. Ductal® JS1000) which require 4 days or more to attain this strength. Accelerated UHPCs tend to have a reduced working time, but work well for these ABC superstructure replacements due to the small quantity of UHPC required and the small placement size needed to complete the connection.

There has also been an emergence of newer UHPC applications, including substructure connections, link slabs, joint headers, bridge deck patching, and thin-bonded structural overlays. The overlay application, in particular, has been implemented on four bridge projects in the U.S. since 2016 (a solution that is regularly implemented on bridges in Switzerland) and has generated much interest as a means to rehabilitate existing structures and provide long-term protection to new bridge decks.

Lastly, the past few years have also seen an emergence of several new UHPC standards in North America, including 1) the ASTM C1856 materials testing standard, 2) the FHWA Checklist for UHPC Connections, 3) a 2019 update to the FHWA TechNote on the Design and Construction of Field-Cast UHPC Connections, 4) the AASHTO LRFD Guide Specification for Accelerated Bridge Construction (which includes commentary on UHPC connections), 5) the ACI Emerging Technology Report on UHPC, and 6) the CSA Standards in Canada to be published in 2019.

This presentation will highlight the above bridge-related activities in North America and showcase a handful of completed projects since the 2016 symposium including the 3-mile long Pulaski Skyway re-decking project in New Jersey, the new cable-stayed bridge in Nipigon, Ontario, and the multi-span superstructure replacement in Bath, Maine. The presentation will close with a brief discussion on what's to come in the years ahead.