

## UHPC: a Durable Concrete Overlay Solution for Bridge Decks

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## 1 Abstract

The key to designing and constructing longer-lasting bridges is through the use of more durable materials. Ultra-high performance concrete (UHPC) is an emerging technology used in bridge infrastructure projects across North America, Europe, and Asia. UHPC is an engineered cementitious fiber-reinforced composite with exceptional strength and durability due to its densely packed matrix, discontinuous pore structure, and micro-crack control. These characteristics significantly delay typical concrete deterioration mechanisms in UHPC. For this reason, bridge specifiers are more frequently including UHPC into their designs. One application of particular interest is the use of UHPC as a thin-bonded, structurally-composite overlay at the surface of the bridge deck. This topping layer provides a riding surface that is both abrasion resistant and virtually impermeable and will protect the conventional materials and elements underneath. Additionally, this layer can be used as a strengthening technique to increase the live load carrying capacity of the existing structure. This solution is being deployed on both new and existing bridges as a rehabilitation strategy and to provide long-term protection to the deck.

**Keywords:** ultra-high performance concrete; UHPC; UHPFRC; bridges; deck; overlay; durability; concrete; rehabilitation; service life.

## 2 Introduction

Concrete remains the material of choice in the construction industry. Being versatile and economical, it is used for an increasingly wide range of applications, from the construction of piers and docks to the production of precast architectural elements. The annual consumption of concrete has recently been estimated at roughly half a cubic meter for every person on the planet. In North America, production is believed to amount to

slightly more than two cubic meters per person per year. This makes concrete the most consumed man-made material, and second only to water as the most utilized material.

This sustained demand for concrete continues to push engineers and researchers to innovate and improve concrete strength and durability. The introduction of new chemical admixtures, for instance, has led to the development of a wide range of products, from high-performance concrete to self-leveling mixtures. At the same time, the increased use of industrial by-products such as fly

<https://doi.org/10.2749/newyork.2019.1613>

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