

A REVIEW OF STRENGTH AND BEHAVIOR OF REINFORCED CONCRETE BRIDGE DECK SLABS OVERLAID WITH ULTRA HIGH-PERFORMANCE CONCRETE (UHPC)

SIVER IBRAHIM ISMAEL* and GHAFUR H. AHMED**

*Dept. of Civil Engineering, Technical Engineering College, Erbil Polytechnic University,
Kurdistan Region-Iraq

**Dept. of Highway Engineering, Technical Engineering College, Erbil Polytechnic University,
Kurdistan Region-Iraq

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ABSTRACT

The use of Ultra High-Performance Concrete (UHPC) for repairing damaged structures has been discovered in recent decades. Unique properties of UHPC give superior structural performance for strengthening the existing bridge or slab. The lack of data has been available in code provisions about this strengthening technology, that is why reviewing the experimental studies can guide application. This literature study presented the experimental database with its evaluation for the number of researchers to examine the effectiveness of strengthening bridges or slabs with UHPC. Also, this study discussed the basic parameters which affect the strengthening process directly, including interface preparation, size effect, characteristics of substrate NSC and characteristics of UHPC overlay. Different failure modes of composite structures were identified under flexure. In addition, based on the existing works of literature an estimate equation has been developed to predict the cracking and failure load of strengthening composite structures. The experimental studies evidenced that the UHPC can prolong the life of existing old structures and reduce the cost of maintenance. Finally, some recommendations are suggested for future work to obtain a more accurate result.

KEYWORDS: UHPC, Bridge, Composite Slab, Overlay, Failure, and Concrete Interface.

INTRODUCTION

The Bridge deck slab is one of the basic loads carrying components of a rectangular layout which is supported directly on the substructures or perpendicular to the support component (AASHTO, 2017) C5.12.2.1. The Deck slab is used as a base for the roadway, railway, pedestrian walkway, and many other facilities, that is why the bridge deck is resistant to cracks and heavy loads continuously. Therefore, the subject of bridge maintenance and development requires significant research and should be considered seriously. So, when designing a bridge, it is very important to give significant attention to decks to obtain good serviceability, safety, appearance, and many other properties because the deck slabs have an important role in providing the aesthetic appearance of the bridge. Furthermore, structurally it has the advantage of reducing deflection and resisting to the moment greatly (Gunavathy & Indumathi, 2011).

Overlaying the bridge deck slab with a suitable material is one of the successful methods for bridge maintenance and service that prolong the life of bridge and behave like a covering coat for the structure. All around the world, several materials were experimentally investigated to be used as an overlay material for bridge deck slabs but were structurally deficient before reaching their design service life. Selecting a suitable material for the overlay requires wide investigation because bridges are subject to high live load due to traffic volume. Usually, bridges are overlaid with some materials such as (NSC, Bituminous, Latex modified concrete, Silica fume modified concrete, Low slump dense concrete, etc.) which cause failure due to weak resistance to tension force and many other deficiencies. Usually, the most common bridge deck deterioration occurs at cracking places that cause water to penetrate or ion down then causing corrosion of steel rebars. Further damage occurs due to freeze-thaw cycles and wheel dynamic loads. A thin layer of UHPC solved all deficiencies that