Design of an innovative composite bridge combining reinforced concrete with Ultra-High Performance Fibre Reinforced Concrete

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Summary

A novel concept is applied for the design and construction of an innovative 46m long overpass road bridge. The principle of this design concept is to use Ultra-High Performance Fibre Reinforced Concrete (UHPFRC) to "harden" only those zones where the structure is exposed to severe environmental and high mechanical actions, i.e. top surface of the deck slab, kerb elements and the zone above the middle support including a unique UHPFRC hinge. All other parts of the bridge structure remain in conventional reinforced and prestressed concrete as these parts are subjected to moderate exposure. This conceptual idea (originally developed for the rehabilitation of existing concrete structures) combines efficiently protection and resistance functions. The resulting bridge has significantly improved structural resistance and durability. By the time of writing this paper, the bridge was in the tendering phase.

Keywords: Bridge design; Ultra-High Performance Fibre Reinforced Concrete; durability; composite concrete construction.

1. Introduction

Concrete bridges show excellent performance in terms of structural behaviour and durability except for the zones that are exposed to severe environmental and mechanical actions. Such zones are in direct contact with liquid water often containing chloride ions from deicing salts leading to premature deterioration due to chloride induced corrosion of steel reinforcement. Rehabilitation of deteriorated bridges is a heavy burden also from the socio-economic viewpoint since it also leads to significant user costs due to traffic disruptions. It can be shown that new concrete bridges built according to today's code provisions still provide insufficient durability. In fact, conventional reinforced concrete hardly withstands severe exposure classes for longer time periods (>50 years), and thus they will also require major rehabilitations during service life.

As a consequence, novel design concepts must be developed for concrete structures that really achieve the required durability over the design service life (of usually 100 years) and beyond. Sustainable bridges of the future will be those where the number and extent of interventions will be kept to the lowest possible minimum of only preventative maintenance without or only little traffic disruptions.

https://doi.org/10.2749/222137807796119753