Extending the life of a historical Bridge through UHPFRC

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Abstract

Designed by Robert Maillart, the Aarebrücke Aarburg (Aargau, Switzerland) stands as a landmark in townscape of Aarburg. This concrete arch bridge with a span of 67.83 m was constructed in 1912.In 1969, the original deck was replaced by a slender deck longitudinally and transversely prestressed. The original slender columns between the arch and the deck, characteristic of this specific bridge, were removed. The bridge was then retrofitted in 1996, but without including a waterproofing. Chloride penetration from de-icing salt used since 1969 is endangering the prestressing of the bridge deck. Due to increased traffic loads the cantilever slabs have been protected from traffic by means of posts. Considering these conditions, a rehabilitation method is sought, capable of increasing the structural capacity of the bridge as well as providing waterproofing. To this end, a UHPFRC (Ultra High Performance Fibre Reinforced Concrete) layer is envisioned.

In this paper, the bridge history is illustrated from the perspective of Robert Maillart bridge developments. Moreover, the strengthening methods employed to increase the lifespan of the bridge are explained, namely the use of UHPFRC on the upper layer and the removal of the expansion joints. The project has been executed as a BIM pilot for the bridge rehabilitations.

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Keywords: UHPFRC, Rehabilitation, BIM, Robert Maillart.

1 Introduction

In 1912, Robert Maillart finalized the construction of the Aarebrücke Aarburg, which provided a connection between the towns of Aarburg and Boningen. The initial design consisted of a slender concrete deck supported on an arch by means of a series of columns (Figure 1), a prototype of the stiffened arch bridge so characteristic and iconic from the engineer. In 1969, a wider deck was required, leading to a) deck replacement in favour of a prestressed solution and b) removal of the intermediate columns, whereas the original arch was preserved and strengthened by rips increasing its stiffness. A lighter retrofitting was conducted in 1996, where the longitudinal beams of the deck were strengthened for shear. However, no waterproofing was provided, resulting in chloride intrusion in the past years which could potentially compromise the transverse prestressing. Since the cantilevering sidewalks were not design for todays traffic loads, in 1996 posts were installed along the pedestrian path preventing heavy traffic to drive on the sidewalks.

In order to improve the structural safety of the bridge and its future maintenance, several measures are implemented. To begin with, the deck is strengthened by means of a UHPFRC layer, which also acts as a new waterproofing layer. Furthermore, the expansion joints and the abutment chambers are eliminated. Along with these interventions, an improvement of the bridge usage is envisioned, condensing the two lines of road traffic towards one side over the cantilever

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