Rehabilitation of a 200 m long pedestrian bridge with carbon textile reinforced concrete

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Abstract

The pedestrian and cyclist bridge *Rheinsteg* of the Rheinkraftwerk Albbruck-Dogern AG (RADAG) constructed in 1934 was on the verge of demolition due to severe corrosion damage. Replacing the defective slab with seven-centimeter thin carbon textile reinforced concrete allowed to maintain the self-weight and to reuse the existing main steel girders, bridge pillars, and foundations. This rehabilitation process globally saved time and cost compared to a new construction. As the existing steel superstructure was again connected monolithically to the new slab to maintain the same level of serviceability, full vertical cracking as well as loads from shrinkage and differential temperature caused by constraint were to be expected. The influence of vertical cracks and tension forces on shear capacity of TRC was investigated during the approval process. This paper presents the project with a focus on TRC and explains insights from the challenging construction on site.

Keywords: bridge, slabs; textile reinforced concrete; shear; tension; experimental investigation; rehabilitation

1 Introduction

Historic steel or reinforced concrete bridges often exhibit severe damage from corrosion. Available methods for repair or retrofitting are typically limited when the self-weight of the constructions is a decisive factor. Current regulations in steel-reinforced concrete design call for increased concrete cover compared to historic constructions, up to 55 mm instead of former merely 15 mm. Hence, simple replacement of defective reinforced concrete slabs in the same dimensions is no solution. Rehabilitation using non-metallic options such as carbon fiber reinforced polymer (CFRP) reinforcement is one promising alternative to demolition and reconstruction. This group of reinforcements consists of bars or grids, and various examples from practice using this innovative material for new constructions [1–3] or strengthening of existing reinforced concrete members [4–6] exist. Especially the resistance to corrosion induced by de-icing agents and the higher reinforcement strength beyond 4000 N/mm² enable construction depths similar to those used in historic steel-reinforced concrete constructions without further protective covers.

Previous CFRP grid- or textile reinforced concrete (TRC) slabs were often produced under controlled environmental conditions in precast concrete plants [7]. This allowed for good quality control despite the smaller tolerances and to utilize special concrete types which were adapted for good compaction of members with a dense reinforcement mesh. Unfortunately, less

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