Investigations on the structural behaviour of CFRP reinforced concrete members for modular bridge constructions

Sven Bosbach, Christian Knorrek, Josef Hegger

Institute of Structural Concrete, RWTH Aachen University, Germany

Alexander Stark

H+P Ingenieure GmbH, Aachen, Germany

Contact: sbosbach@imb.rwth-aachen.de

Abstract

The requirements for existing bridge structures increased significantly in the last years because of increasing traffic volume and higher total vehicle weights. Strengthening of existing bridges as well as necessary reconstructions are expensive, often complex and strongly influence traffic. Hence, the development of new methods for sustainable bridge constructions with short erection periods becomes a macroeconomic issue. Modular bridge constructions made of precast concrete elements with reinforcement systems made of corrosion-resistant carbon fibre reinforced polymer (CFRP) represent a particularly suitable solution for these demands. Modular systems are reasonable to realise short construction times and the application of durable CFRP reinforcement ensures a longer lifetime of the bridge. This paper reports on a developed concept for a modular system made of prefabricated concrete elements with CFRP reinforcement and on tests investigating the structural behaviour of prestressed CFRP reinforced concrete members.

Keywords: Precast concrete, modular bridge construction, prestressed concrete, CFRP, textile reinforcement, bending, shear.

1 Introduction

For modular bridge constructions made of carbon fiber reinforced polymer (CFRP) reinforced concrete elements, the individual parts of the system must be analysed first. For large spans and filigree cross-sections, the modular members have to be prestressed to prevent too large deformations in consequence of cracking. To extend lifetime of the concrete parts of the bridge system, non-corrosive CFRP strands were applied as pretension members. For an economic and safe design, the behaviour of CFRP members in high performance concrete (HPC) has to be investigated. The dimensions of the bond anchorage zone determine the thickness of the elements since a minimum concrete cover has to be provided to avoid splitting cracks in the transmission zone. Additionally, the structural performance of the elements must be investigated.

In the past, intensive research has been executed on CFRP reinforced bridges and some practical applications have already been realized. Examples are the bridge street bridge in the US [1] or lthe Shinmiya Bridge in Japan [2]. In the last decade, some bridges with so-called textile reinforcement have also been realized in Germany. Here, reinforcement systems made of alkali-resistant

https://doi.org/10.2749/ghent.2021.1163