Monitoring and Inspection of a Fiber Reinforced Polymer (FRP) Road Bridge

Markus Gabler
Arup, Dusseldorf, Germany
formerly: Institute for Building Structures and Structural Design (ITKE), U. o. Stuttgart, Germany

Eberhard Pelke
Hessen Mobil, Wiesbaden, Germany

Jan Knippers
Institute for Building Structures and Structural Design (ITKE), University of Stuttgart, Germany

Contact: markus.gabler@arup.com

Abstract

The Friedberg Bridge in Germany was the first FRP - steel composite road bridge in Europe when it was opened to traffic in 2008. The bridge has a span of 27 m and a total width of 5 m. It had been designed for full vehicle live load as per EN 1991 with the then applicable NA for Germany. An extensive senor network had been installed to investigate the structural behavior of the bridge when subjected to daily temperature cycles and live loads. The bridge has also been visually inspected over the first years of use.

This contribution will present the sensor readings during load tests and daily temperature cycles. The results allow for assessment of the load bearing behavior of the FRP deck and adhesive interface of the deck to the steel girders as well as long-term effects. This can be used for calibration of a detailed FEA model of the bridge, which can be used for future design tasks of FRP bridges. For example, the analysis shows that the contribution of the surfacing layer as well as the parapets is non-negligible for proper modeling of the structural behavior.

The load testing was supplemented by visual inspections, which didn't showed any visible damage to the adhesive layer nor the FRP deck.

Keywords: FRP; GFRP; Monitoring; Sensors; SHM; Adhesive; Maintenance

1 The Friedberg Bridge

1.1 Structural System

The Friedberg Bridge has a steel – FRP composite superstructure. Both components are adhesively bonded together with an epoxy grout (Figure 1). The superstructure is fixed to both RC abutments and thus forms a frame structure. The advantage is that hogging and sagging moment are of similar magnitude. Compared to a simply supported beam, this allows for a slender design. Also, a central pier can be omitted. The composite action achieved by the FRP deck reduces the vertical displacement of the superstructure by approx. 20% compared to the steel girders alone. This is less than with steel – concrete composites, but still a significant saving.

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