Strengthening of road composite bridge using Fe-SMA

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Abstract

Exceeding creep actions on newly built composite bridge in Karlovy Vary led to rapid repair works of the excessively deflected structure. Activation of retrofit prestressing system in confined places is usually a difficult task. Instead of space-demanding hydraulic actuators, prestressing system of thermally activated shape memory alloys was used under low filler beam bridge to act against the creep inflicted deflection. Method of thermal activation of Fe-SMA with use of heating ceramic pads with resistance wire was performed on all of 17 filler beams. This method was proven as most suitable for field activation in previous application. Strengthening was done in February 2021 without any intervention into the traffic on the bridge. It is the first permanent Fe-SMA application of its kind in the world. Wireless monitoring of the bridge started before the prestress activation and continued for several months. Static load test with use of 32-ton trucks was conducted. Based on the long-term monitoring, the relaxation of Fe-SMA is evaluated and compared with the results from the experimental analysis conducted in laboratory conditions on the same retrofit system.

Keywords: Structural monitoring; Shape memory alloy; Roadway bridge; Strengthening; Sustainability.

1 Introduction

The ageing transport infrastructure has been a major issue in recent years. Most bridge structures around the world are reaching or exceeding their design life. As can be seen from [1], bridges in the Czech Republic are no exception. Our research team has focused on new strengthening methods suitable for historic bridges, however in this case study example, the defective and subsequently strengthened bridge structure is relatively new. The solution of strengthening the structure with Fe-SMA was selected from several options. The main advantage was primarily the ease of working in confined conditions and the application without need of any traffic restrictions.