Long-term vibration monitoring on railway bridge KW51 in Leuven, Belgium

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Abstract

Railway bridge KW51 in Leuven, Belgium, has been continuously monitored since October 2018. During the monitoring, the bridge was retrofitted to resolve a construction error that was noticed during inspection. The aim of the measurements is twofold. First, the strain measurements on the bridge deck are used to validate virtual strain sensing, which can be embedded in continuous fatigue monitoring to assess the stress cycles under train loading in critical details which are not measured. Second, it is investigated to what extent continuous monitoring of the modal characteristics of the bridge enables detecting changes in the structure that could potentially be attributed to damage. In this case, the retrofitting results in an actual state transition, which, as shown, can be identified from the natural frequency data. This paper summarizes the first results of the measurement campaign.

Keywords: Structural health monitoring, system identification, virtual sensing, railway bridge KW51

1 Introduction

Railway bridge KW51, shown in Figure 1, is located on railway line L36N between Leuven and Brussels, Belgium, where it enables the crossing of the canal Leuven-Mechelen. The bridge, of the type bow-string, has a length of 115 m and a width of 12.4 m.

Figure 1. Railway bridge KW51.

The railway bridge consists of two ballasted tracks, both characterized by a curve radius of about 1120 m. A maximum speed of 160 km/h is imposed. A monitoring system was installed on the bridge in September 2018. The measurement setup, which is briefly recapitulated in Section 2, is described in detail in [1].

In the period from 15 May to 27 September 2019, the bridge was retrofitted to resolve a construction error that was noticed during inspection. The retrofit consisted of strengthening the connections of the diagonals to the arches and the bridge deck. For every diagonal, a steel box was welded around the original bolted connection at the intersection with the arches and the bridge deck (Figure 2).

The measurements were originally set up to validate the application of virtual sensing for continuous fatigue monitoring of steel railway bridges. The first results obtained from the virtual sensing are presented in Section 3. In addition to the strain measurements that serve the virtual sensing, continuous acceleration measurements

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