Properties of Structural Steels in a Railway Plate Girder Bridge

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Abstract

The results of an examination on structural steels of different grades from a three-span plate girder bridge are presented. The riveted structure consists of six spans of a similar structure but constructed at different periods over the bridge's service life, with two of the spans estimated to be original and dating from 1873. The structure has degraded at different levels, along with the amount of corrosion. The testing of naturally ageing and normalised specimens enabled the steel degradation and effects of ageing to be assessed. Along with mechanical properties, the weldability of the steels was also assessed.

Keywords: railway bridge; riveted bridge; cast steel; ageing of steel; durability.

1 Introduction

Every structure undergoes gradual structural and material degradation [1-4]. In the case of railway infrastructure, this particularly concerns railway bridges. Their maintenance and technical efficiency enable the required service parameters for managed railway lines such as speed, axle weight and structure clearance to be preserved [5]. A structure degrades with differing intensities depending on service time, type of structure, location and loading.

Polish Railways manage over 32 000 railway engineering structures including more than 7 400 bridges and viaducts of a total length of over 234 km. The majority of these structures are rather old: 54,3 % are over 91 years old. Over 1 500 bridge structures are deficient and require urgent repairs or upgrades to restore their service parameters. Over the past decade, many railway bridge structures have been repaired or upgraded. The bridge presented in the paper was also designated for refurbishment. The refurbishment design was drafted by the one of the paper's authors. When drawing up the design it was necessary to assess the grade and the subgrade of the steel used in the structure as well as its yield strength [6-9].

As the bridge structure was planned to be modernised using welding, the steel's weldability required assessment. These parameters were calculated and presented in the paper. The general methodology for the assessment procedure is given. This procedure may be helpful in the retrofitting and repair of similar bridge structures.

2 Bridge characteristics

The bridge is located on a double track railway line over the narrows of the Pakoski Reservoir in central Poland. The railway line was constructed in 1873 and it is assumed that the supports or their main sections date from that time. The three span underbridge is of a riveted plate construction.

The fish belly spans are simply supported with lengths of 18,9 m, and the total length of the bridge is 59 m (Fig. 1). The web height of the plate girders is 1,45 m at the supports and 1,80 m at midspan.

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