Removing Weak Spots from Railway Lines

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Summary

A new modernisation programme for Polish Railways was introduced several years ago; however, this had to be preceded by a "weak spot removal" programme, where highly deficient structures were upgraded or replaced. This paper describes three railway bridges which were rebuilt during the programme. The bridges are located on main double track lines and were designated for upgrade by their regional railway agencies. The bridges were rebuilt using different techniques such as refurbishing and strengthening of an existing structure, partial rebuilding with replacement of the superstructure and full replacement. For the new superstructures, ballast track was used.

Keywords: railway bridge; assessment; retrofitting; strengthening; replacement; culvert.

1. Introduction

The length of Polish railway lines in service deceased from 24 100 km in 1990 to 19 000 km in 2006. Low maintenance over several decades resulted in damage to the railway infrastructure, with many structures urgently needing upgrading or replacement. Several programmes for improving and modernising the railway infrastructure, both at a national and regional level, were implemented. During the project, selected highly deficient engineering structures and tracks were refurbished or replaced. The deficient bridges are located on major national lines and were designated for repair. The contract was a "design & build" project and the author was responsible for carrying out the investigations and preparing the concepts and technical designs for the bridges. The different techniques adopted for rebuilding the defective bridges ensured that the removal of weak spots was successful, but not without problems. The rebuilding of the bridges was carried out from 2007 to 2008.

2. General procedure of the project

The contract for improving the railway infrastructure included the rebuilding of three bridges on different lines, strengthening sub-grade line and rail replacement on a section of the Wrocław-Szczecin line and the replacement of a few culverts on different lines. The structures had been declared obsolete and, due to their poor condition, a speed and weight restriction had been introduced. The decision to replace or refurbish a particular bridge had been taken following feasibility studies by the regional railway administration. However, in order to execute the works, complete design stages preceded by full administrative procedures were required. General requirements for the bridges in each of the refurbishment designs and execution of works were:

- an increase in the load bearing capacity of bridges to the highest railway loading class with min axle load 22,5 t and speed up to 160 km/h
- an adjustment in bridge widths to accommodate clearance on modernised and electrified lines
- use of a ballast track for new superstructures
- strengthening of transition sections on approaches
- equipping bridges with sidewalks for workers
- rebuilding the drainage system for the bridges and approaches

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- meeting environmental requirements for construction and water flow
- minimising disturbance to rail traffic during execution of the works

3. The deficient bridges

The first bridge designated for strengthening and upgrading is on the Poznań and Skandawa Railway (Fig. 1 left). The bridge has riveted plate girder spans and massive supports. The bridge is located near a town where a chemical plant produces soda for the food-processing and chemical industries. This results in a corrosive environment which influences the steel bridge structure. Replacement of the track structures, bearings and sidewalks was necessary. Strengthening of the steelwork and the replacement of corroded elements were also necessary. Corroded plates of were replaced by new thicker plates in the upper flanges in the four spans. The severely corroded gusset plates and diagonals of the wind bracings were replaced with new ones. Huck lock bolts were used as permanent fasteners. Designs were drawn for the repair of the brickwork supports and rebuilding of the abutments with new reinforced concrete backwalls and wings. New bridge timber sleepers were supported on centring devices. Centring shims on the upper flanges of the plate girders were site welded. A general view of the bridge is presented in Figure 1 (left photo).

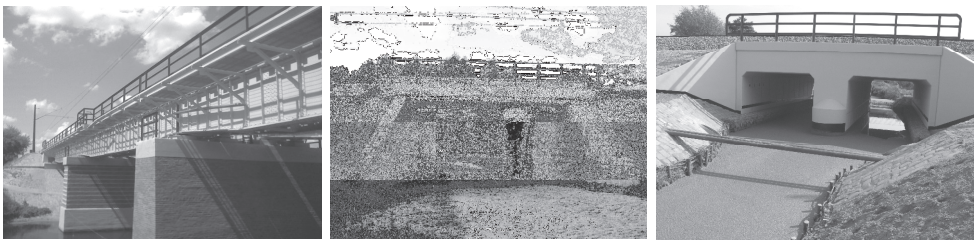

Fig. 1: General view of the bridges after rebuilding

The second bridge is a viaduct on the Wrocław and Szczecin Railway. The superstructures, both steel and reinforced concrete, were in very poor condition and were designated for replacement. The railway agency chose steel beams in a concrete deck for the new spans. To minimalise construction time, each span was prefabricated in two units with a cast in situ longitudinal joint. A side view of the viaduct after rebuilding is presented in Figure 1 (centre photo). The stone wings were heightened with reinforced concrete. All the concrete sections in the abutments, old and new, were faced with semi-stone plates, making the view of the bridge more aesthetically pleasant. The old stone parts of the abutments were cleaned, repaired and protected with a hydrophobic coatings.

The third bridge which was designated for replacement is on the Warsaw and Kunowice Railway. The railway line is part of the E20 international transportation corridor linking West and East (Berlin and Moscow). The bridge was constructed in 1947 and problems with the integrity of the spans arose a few years later because an intermediate support was added. The additional support allowed the survival of the bridge for several decades further but under-maintenance and excessive leakage caused the concrete to disintegrate over the years. The railway agency allowed the bridge to be replaced by a concrete box culvert. The prefabricated structure for the culvert pipes was developed. To avoid using a temporary waybeam structure it was decided to construct the new culvert under the existing bridge whose spans would still be carrying two tracks of the line during the works. A view of the culvert after rebuilding is presented in Figure 1 (right photo).

4. Conclusions

Ageing and degradation with low maintenance causes heavy wear of the railways and their structures, resulting in the necessity for refurbishment or the renewal of obsolete old structures.This paper has presented part of the project for improving the railway infrastructure, which involved the renovation of three existing railway bridges. Because of the different levels of degradation in the structures, different methods for upgrading were employed. Refurbishment, partial replacement and bridge replacement with a precast culvert were carried out.