



## Refurbishment of the masonry arch railway bridge Merxem Street

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## Summary

Because of the widening of the Albert Canal, one of the most important canals in Belgium, a number of railway bridges have to be replaced by longer spans on new embankments. Since the widening also necessitated a larger free height for ship traffic under these bridges, the overall length profile of this railway line had to be changed. This resulted in the replacement of two other railway bridges, the Merxem Street Bridge and the Iron lane Bridges, in accordance with the new length profile. The bridge closest to the canal, the Merxem Street Bridge, is a classic masonry arch bridge. Ten years ago, a new tubular arch bridge was built next to it for the high speed railway line from Antwerp to the Netherlands. Due to the influence of time and the increasing traffic, and especially ballast, loads and volumes on the bridge since the early 1900s, the existing masonry bridge needs to be renovated and strengthened. Strengthening was chosen over the construction of a new bridge because of the historical value of the existing masonry arch and since the overall structural state of the bridge was quite good. A new concrete deck was installed on top of the masonry arch ensuring that the higher live as well as dead loads will be spread over a considerable part of the arch length. This new deck was a combination of precast concrete elements with on-site concrete construction. The paper will focus on this combined concrete design and its realisation. Ultimate load carrying capacity of both existing and strengthened situation was verified using rigid block analysis. Critical failure modes of both structure and backfill are checked and the strengthening ensures that the most precarious modes are avoided because of the additional stiffness and load dispersion.

**Keywords:** Arch bridge, refurbishment, masonry, precast concrete elements, strengthening, railway bridge.

## 1. Introduction

This project is one of the components of a much larger project concerning the widening of the Albert Canal, one of the most important canals in Belgium, connecting the Port of Antwerp with the Industrial area around Liege and offering access to the Ruhr area in Germany. This project wants to increase the capacity of the Canal, allowing larger barges to travel easily with containers stacked two high. A number of railway bridges have to be replaced by longer spans on new embankments along the entire length of the canal. Since the widening also necessitated a larger free height for ship traffic under these bridges, the overall length profile of this railway line had to be changed. This resulted in the replacement of two other railway bridges close by the considered Merxem Street Bridge, more specifically the Albert Canal Bridge and the Iron Lane Bridges, in accordance with the new and improved length profile. The bridge closest to the canal, the Merxem Street Bridge, shown in Fig. 1, is a classic masonry arch bridge. The masonry uses the bonded brick concept: the span consists of multiple rings of masonry that act as if they were one (e.g. if the barrel contains 'header' bonded brickwork, where certain natural stone blocks are laid 'end-on' to provide a mechanical connection between rings). Ten years ago, a new tubular arch bridge (shown in Fig. 2) was built next to it for the construction of an additional high speed railway line. This new high speed line will connect Antwerp to the Netherlands.