



## Strengthening of Riveted Connections of a Steel Arch Bridge: Lessons Learned

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### Abstract

As part of an extensive renovation program, Arup Netherlands delivered engineering services for the strengthening and renovation of 8 large steel bridges in the Dutch highway network. Strengthening of the riveted splice connections at the ends of the hangers of a steel arch bridge on the Dutch A2 motorway represented a significant challenge to extending its life by 30 years.

This paper describes the key features of and lessons learned during assessments, investigations, design development and execution of a strengthening solution to resolve the issue.

**Keywords:** Steel bridge, tied arch, riveted connections, assessment, strain measurements, load test, design refurbishment, strengthening, fatigue.

## 1 Introduction

### 1.1 General

Boogbrug Beek is a steel tied arch bridge which carries the A2 motorway over the Amsterdam to Maastricht railway, see Figure 1.

Originally constructed in 1969, by 2009 fatigue damage to the bridge's orthotropic deck had cast doubt over the long term future of the bridge.

As a result the Dutch national transport authority Rijkswaterstaat (RWS) selected this bridge together with seven others for renovation with the aim of ensuring a further working life of at least 30 years. The fatigue problem in the deck was to be solved by means of repairing the fatigue cracks and application of a high strength concrete (HSC) overlay to reduce fluctuating stresses

caused by freight traffic. The main load bearing structure needed to be assessed and if necessary strengthened to support the additional weight of the overlay and increased traffic loads.

The focus of this paper is the structural analysis, and the development and execution of a strengthening solution for the riveted connections that connect the hangers to the arches and deck.



Figure 1. Boogbrug Beek before renovation