Major maintenance and strengthening of eight steel arch bridges in The Netherlands

The rebuilding of the Weesperbrug

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Summary

The Weesperbridge is one of the eight bridges in the maintenance project which will be replaced by the Contractor, in a project for major maintenance and strengthening of this steel arch bridges. For the engineering much analyzes should be made. Each analyse expects a FEM model with different level of detail. Analyzes are made of strength, fatigue and stability.

The transportation and installation of the new bridge has its restrictions. So there are the limited height of the other bridges across the Canal and the restriction to obstruct the river for a maximum of eight hours. These restrictions require an efficient and well-prepared method for the installation.

Keywords: steel, fatigue, buckling, heavy lifting, transportation en installation

1. Introduction

The Amsterdam-Rhine Canal is one of the main waterways in The Netherlands. The canal is an important connection between the port of Amsterdam and the Ruhr in Germany, making it one of the busiest canals in the world. Rijkswaterstaat, the administrator of the canal, put out a request for tender for the major maintenance and strengthening of its steel arch bridges, to guarantee a residual life of 30 years. The contractor decided to replace some old bridges with new ones, instead of doing lengthy and risky maintenance and reinforcement activities.

Fig. 1: The old Weesperbridge

2. The Replacement of the Weesperbridge

The Weesperbridge is located east of Amsterdam and dates back to 1937. The Weesperbridge is one of the eight bridges in the maintenance project which will be replaced by the Contractor.

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3. Modeling

For the engineering of the steel structure, different types of finite element models have been used. The expected output of a model depends on the analysis to be performed. We used one global headmodel and different kinds of detailed sub-models. The sub-models are always based the global headmodel.

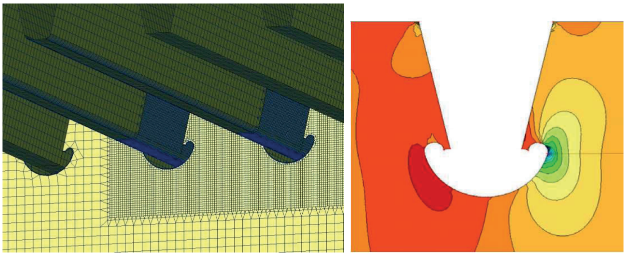

Fig. 2: The refining and calculation of stresses around the cope hole in the crossbeam

4. Analyses on fatigue

The dimensions of the orthotropic deck will be mainly determined by the analyses of fatigue in the deck plate during its lifetime. Also parts of the main structure like the arch, maingirder and crossbeam have to deal with the fatigue problem and have to be examined. The main structure will be examined separately from the deck structure. For both analyses the spectrum of trucks must be determined.

5. Arch buckling

It was decided to accurately calculate buckling lengths of the arch by using the finite element method (FEM). An example of the buckling length corresponding lowest ownvalue is given in Fig. 3

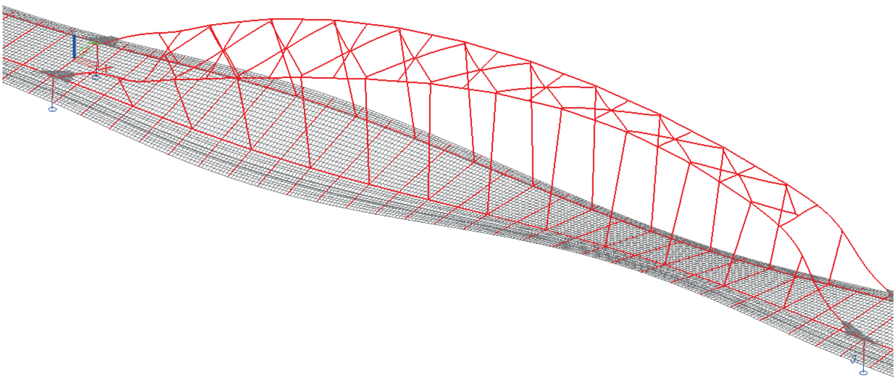

Fig. 3: Out of plane buckling (n=9.7)

6. Structural aspects during the installation

The transportation and installation of the new bridge has its restrictions. So there are the limited height of the other bridges across the Canal and the restriction to obstruct the river for a maximum of eight hours. These restrictions require an efficient and well-prepared method for the installation. Every step should be engineered.