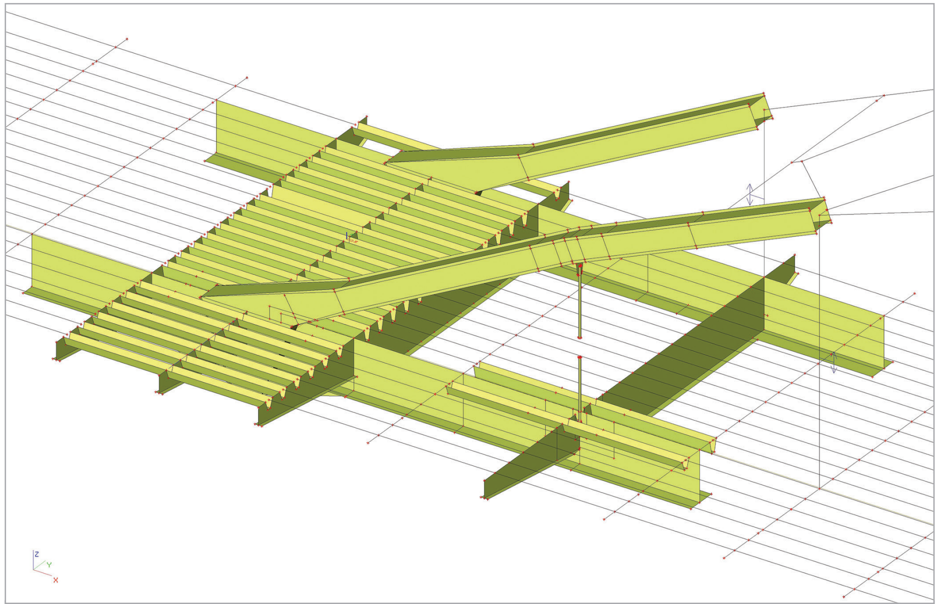
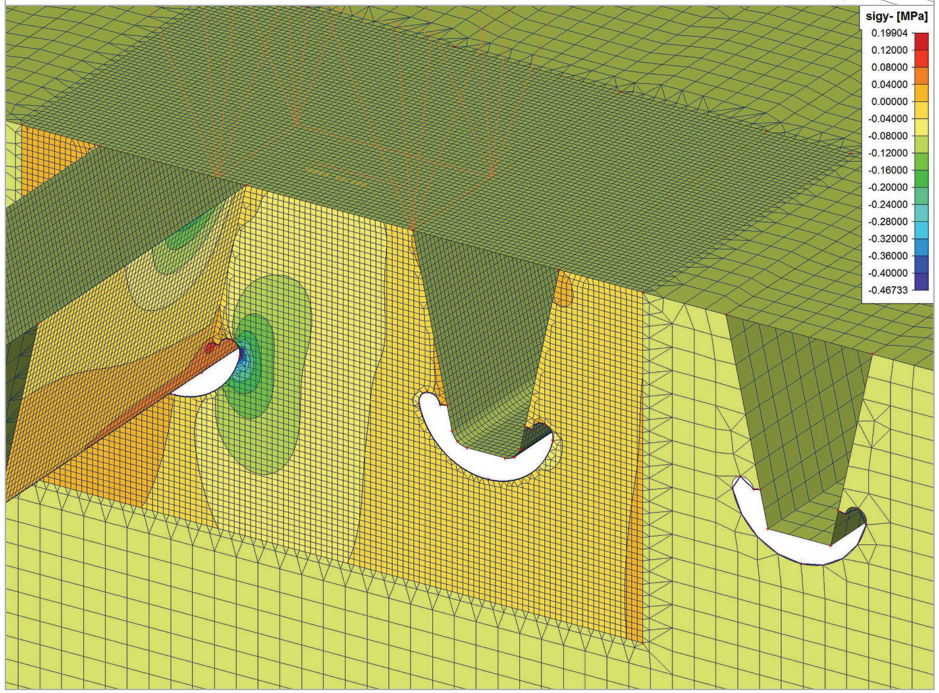
"Weesperbrug" Arch Bridge - Weesp, The Netherlands





The Weesperbrug is located south-east of Amsterdam and dates back to 1937. The bridge has the total length of 144 m, with a main span of 96 m. The bridge crosses the Amsterdam-Rhine Canal. 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 inland canals in the world. Rijkswaterstaat, the administrator of the canal, put out a request for a 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 the old bridge with a new one, instead of pursuing lengthy and risky maintenance and reinforcement activities. The new bridge will have an orthotropic steel deck, whereas the old bridge has a concrete deck. Therefore, the new bridge weighs considerably less than the old bridge, so the concrete foundation can be reused.

The Weesperbrug is one of eight bridges in the maintenance project which will be replaced by the contractor. The method of exchanging the old for the new bridge will minimise the nuisance to shipping on the Amsterdam-Rhine Canal and the environment. The new Weesperbrug will be constructed at the works of the contractor in Gorinchem, located at the river Merwede. This location has an advantage for transportation because the bridge can be transported across the river, over the North Sea and through the North Sea Canal to its final location on the Amsterdam-Rhine Canal.

The use of Scia Engineer

The calculations for the design of the new Weesperbrug are made using Scia Engineer. Furthermore, the temporary situations of removing the old bridge and placing the new one have been analysed.

Different types of models have been made for different types of verifications. At first a main model has been made. This model consists of the steel deck in 2D elements and all the other elements in 1D members. This basic model is used for:

- Elaboration of forces in the main structure;
- Assessment of the main structure on the strength;
- Assessment of the main girders, arch and pendants on fatigue;
- Assessment of the (arch) stability;
- Assessment of dynamic (wind) effects on the pendants.

The arch stability is checked by finding the lowest buckling mode with corresponding n-value. These are used to calculate the critical buckling load and the buckling length, which were used in a buckling check in accordance with the Eurocode. For the dynamic wind effects on the pendants, a geometric nonlinear calculation was made for a realistic value of the stresses in the pendant at a certain amplitude.

The Weesperbrug has an orthotropic deck structure consisting of a steel deck plate with troughs as stiffeners. A sub-model consisting completely of fine-meshed 2D elements was integrated into the main model to analyse the fatigue life. To carry out a good fatigue assessment, influence lines are needed. These are created with Scia Engineer by placing an axle load every 40 cm. This is realised by using the function Traffic Loads (Lane Loads Manager). Furthermore, the result per load (axle load location) could be exported to a spreadsheet by using the detailed results in the mesh node. Finally, the fatigue assessment is realised in the spreadsheet.

In another sub-model the most important connections are modelled using 2D elements with a fine mesh. In this model the strength of these connections is assessed. Again, the sub-model is integrated into the main model for realistic preconditions and forces. The connections checked by using this model are:

- Arch - Pendant
- Pendant - Main girder
- Arch spring - Main girder

Since there is only a couple of hours' time available to place the new bridge, it is placed in one piece from a pontoon on the canal. For some parts of the main girder this situation gives the largest stresses. In the main model the supports and loads are changed to verify all temporary situations.

Software: Scia Engineer

Movares

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Project information

Owner	Rijkswaterstaat
Architect	Studio SK
General Contractor	Mercon Steel Structures
Engineering Office	Movares Nederland
Location	Weesp, The Netherlands
Construction Period	10/2012 to 06/2013

Short description | **“Weesperbrug” Arch Bridge**

The Weesperbrug is located east of Amsterdam and dates back to 1937. The bridge has the total length of 144 m, with a main span of 96 m. The bridge crosses the Amsterdam-Rhine Canal. The contractor decided to replace the old bridge with a new one, instead of pursuing lengthy and risky maintenance and reinforcement activities. The new bridge will have an orthotropic steel deck, whereas the old bridge has a concrete deck. Therefore, the new bridge weighs considerably less than the old bridge, so the concrete foundation can be reused. Scia Engineer has been used throughout the project. A main model is used for strength verifications and fatigue calculations of the main bearing structure. This model is also used for the stability calculations of the arch. Detailed models have been implemented in the main models for verifications of strength of connections and the fatigue life of the orthotropic steel deck.