Ney & Partners

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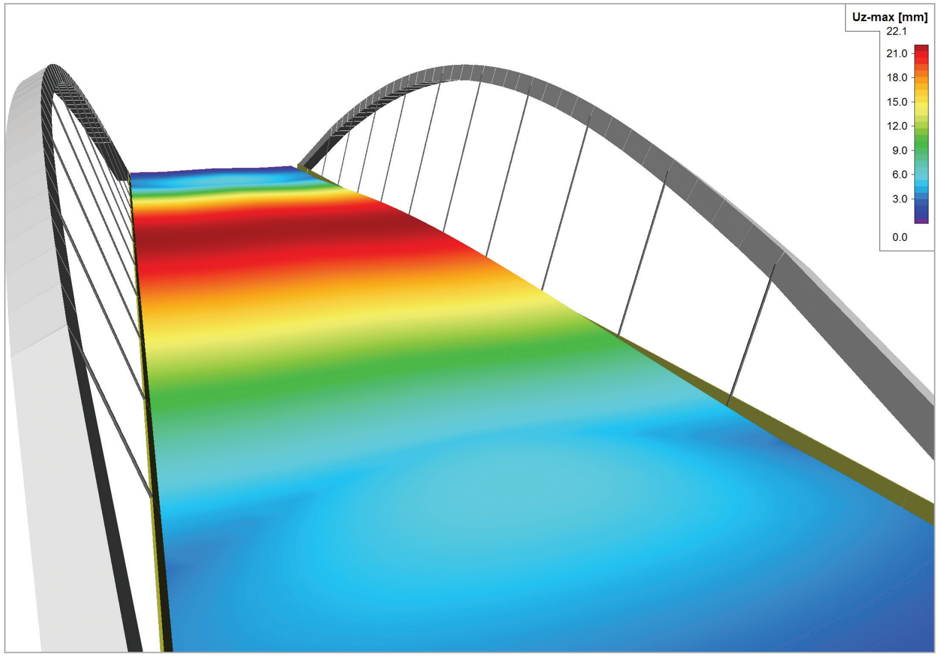
Ney & Partners is a structural engineering consultancy, established in Brussels. Since its foundation in 1997, the office has worked with an active view on the art of engineering through the integration of the different civil works disciplines.

This integration and optimization of structural elements aims to overcome the classic hierarchic assembly of constructive solutions. Innovative bridges, roof structures and works of art developed by our office, express most clearly this vision.

The construction project quality lies in the synthesis of specific design constraints. The structural aspect is of primary importance to this synthesis. From the very beginning of the design process, Ney & Partners conducts a constant research for advanced engineering integration. In doing so, our position as Engineering Consultancy overcomes the standardized dimensioning of predefined technical solutions.

Ney & Partners currently employs more than 45 civil engineers, architects, draughtsman, etc.



Software: Allplan Engineering, Scia Engineer

Harchies Tied Arch Bridge - Bernissart, Belgium

Architectural project and stability study.

Context

The SPW (Walloon Public Administration), through the Directorate of Waterways Mons, decided to replace the bridge Harchies-Stambruges on the Bernissart municipality. This prestressed concrete bridge spans the Nimy-Blaton Canal and shows strong degradation of the prestressing cables due to excessive corrosion.

Project description

The new bridge is a tied arch bridge with integral abutments: thermal expansions of the bridge are compensated by soil-abutment interaction. This bridge typology is therefore jointless. The span of the bridge is 70 m and the width of the deck is 14 m. The arch has a trapezoidal shaped cross section, with integrated lighting features. The plane of the arch is inclined. The total weight of the structural steel is 250 t. The steel structure is connected to the concrete abutments using post-tensioned steel rods.

Difficulties specific to the project

For the calculation of the bridge, several effects had to be taken into account.

Construction phases have an important influence on the behaviour of the bridge.

The tie is connected to the concrete deck. Therefore, important tensile stresses are introduced in the concrete in the longitudinal direction of the bridge, and cracked concrete needed to be modelled for certain verifications. Also the behaviour of concrete under long term loading was modelled.

Because of the integral typology of the bridge, thermal expansions will result in deformation of the soil and thus in horizontal ground pressure. The interaction soil-structure and its influence on the structure itself, needed to be implemented in the calculation. The stiffness of the soil behind the abutments and under the foundations has an influence on the internal forces of the bridge elements. Because of the unpredictable behaviour of the soil, minimum and maximum stiffness values were used.

To model all the previously mentioned effects, twenty models differing in certain parameters (such as temporary stage geometry, Young's module of concrete, soil stiffness, etc.) were needed.

Use of Scia Engineer

Scia Engineer was used for a 3D modelling of the bridge. Several functionalities were used in the calculation. The most important ones are described below.

In the design stage, where changes of geometry occur frequently, 'Allplan roundtrip' was used. This allowed to make the changes only in a base model, and to adapt these changes automatically in the other models.

The 'Productivity toolbox' functionality proved to be very useful for this project. Calculation results (such as internal forces) of the different models were exported in numerical values, so that they could be combined to make a global envelop.

The trapezoidal shaped cross section was modelled using 'General cross-section'.

'Soil support on 2D member' was used to take the soil stiffness into account.

Because of the slenderness of the arch section (span / section height ratio of about 150), the arch is sensitive to buckling. Therefore, the stability was analyzed with the 'Stability analysis' functionality.

A modal analysis was done using the 'Dynamics' functionality.

Finally, a more detailed 3D model was made for the connection of the steel structure and the concrete abutment. In this model, the required number of tension rods and the prestress necessary to insure contact between steel and concrete under all circumstances were determined. A 'Soil support on 2D member' with a nonlinear function was used to model the contact of the steel with the concrete. A nonlinear analysis was needed for the calculation using the 'Geometrical non-linear' and the 'Geometrical nonlinear analysis surfaces' functionalities.

Harchies Tied Arch Bridge

Bernissart, Belgium

Project information

Owner	SPW
Architect	Ney & Partners
Engineering Office	Ney & Partners
Construction Period	From 2011 to 2012
Location	Bernissart, Belgium

Short project description

The new Harchies bridge, spanning 70 m, replaces the existing prestressed concrete bridge on the Nimy-Blaton Canal. The replacement is required because of the corroded strands of the latter.
The new structure is a bowstring bridge with integral abutments: the thermal expansions are compensated by soil-abutment interaction. This bridge typology is therefore jointless. The arch has a trapezoidal shaped cross section, with integrated lighting features.