TUC RAIL

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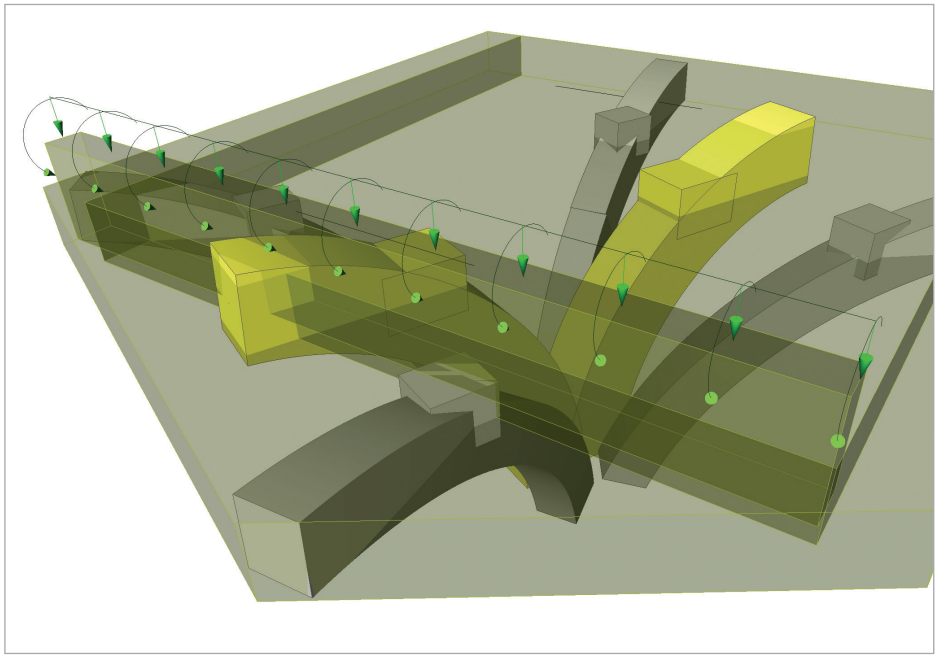
TUC RAIL was established in 1992 as a subsidiary of the Belgian national railway company (NMBS/SNCB). In 2005, the railway company's shares in TUC RAIL were taken over by Belgian railway infrastructure manager Infrabel. TUC RAIL's core competencies include project management, design and execution of the work, both in constructing new rail infrastructure and in adapting existing infrastructure. On the Belgian market, this means working on large and complex projects in order to extend and modernise one of the world's busiest railway networks situated at the heart of Europe.

TUC RAIL also offers its services and competencies to foreign projects, enabling it to capitalise on acquired knowledge, to face new challenges and to diversify its experiences.

The company has more than 900 employees and achieved a turnover of almost € 81 million in 2009. TUC RAIL can boast 18 years of experience and is therefore able to offer its clients reliable, tailor-made, high quality solutions, from the design stage up to the realisation of the project.



Software: Scia Engineer

Diabolo "Iris Viaduct" - Zaventem, Belgium

This Diabolo project concerns the northern extension of the existing terminus station in Zaventem airport.
A new railway line will be built in the central reservation of the E19 motorway, creating a connection in the direction of Brussels, with a junction to the rail facilities at Schaarbeek, as well as a connection in the direction of Mechelen, with a junction to the railway bypass before Mechelen station.
TUC RAIL conducts preliminary studies, initiates (and in some cases finalises) project studies until issuance of the building permit and oversees the execution of the project until the new infrastructure will enter into service.

Structures and final design

The Diabolo project consists of numerous individual projects. The western branch crosses the border of the Brussels-Capital Region and from this point on, the project "Diabolo Haren" starts. Summarized this project consists of 1.5 km of railway infrastructure for 2 tracks with 3 huge abutments, numerous retaining walls, two underpasses, 2 huge embankments and 2 viaducts.
The most western viaduct is called the "G-viaduct" and crosses the railway bundle G of Schaarbeek.
It consists of 7 spans: 2 spans with preflexed and prestressed beams, 1 span with prestressed beams and 4 impressive spans of 60 m with a mixed steel-concrete section. The total length of the G-viaduct is about 350 m.
The most eye-catching part of the project however is the "Iris Viaduct", which derives its name from the iris flower, the symbol of the Brussels-Capital Region. The area in which the viaduct is built, is designated as a future residential living area. Therefore the architectural design of this concrete viaduct was an important element in obtaining the building permit.
The viaduct has a total length of 1.12 km containing 35 spans. At the eastern abutment, two separate viaducts depart, each carrying one single track. After 4 spans, they merge into one viaduct carrying the two tracks. In the middle of the viaduct, the first piers of a possible future side-branch are already integrated in this project.

In general the viaduct contains two types of concrete pier heads, depending on the number of tracks. The pier heads carrying two tracks consist of 6 three-dimensional curved slender arms, starting from the top of the pier body and opening to support the top concrete plate. The pier heads carrying one single track are shaped according to the same principles but consist of only 4 arms.

The body of the bridge pier itself has a varying cross-shaped section. Given that the viaduct crosses a terrain with variable level, the height of the body of the piers varies between 6 m and 14.8 m. The pier heads have a constant height of 4.8 m. The highest pier has therefore a total height of 19.6 m.

The whole project is built in an area with very poor soil characteristics. Therefore, each construction, even the embankments, are supported by foundation piles. Each pier is supported whether by 120 micropiles or by 30 screw piles.

Design criteria

Scia Engineer was used for determining the internal forces in the three-dimensional curved arms, the distribution of the horizontal forces (braking, acceleration and centrifugal forces) over the total viaduct and the displacements in the viaduct (longitudinal and transversal).

The main goal in the designing process of these special piers was to make the arms as slender as possible. The curved shape of these arms initiates enormous bending moments around the two principal axes, as well as normal forces, shear forces and torsion. Hand made calculations could not take into account all realistic boundary conditions such as continuity of the rails, characteristics of the semi-mobile supports and the distributing function of ballast. Therefore a complex model of the whole viaduct was created, incorporating springs to reflect the presence of the rails, ballast…
Each element of the construction - piers, decks, foundation - was modelled with its realistic stiffness, in order to obtain a realistic view of the force distribution in the viaduct and transversal and lateral deformations. The results of this model were compared to the currently applied standards for railway infrastructures, such as vertical and horizontal deflexions, rotations and total deformation.

Diabolo “Iris Viaduct”

Zaventem, Belgium

Project information

Owner	Infrabel N.V.
Architect	TUC RAIL
General Contractor	SA Valens-Antwerpse Bouwwerken
Engineering Office	TUC RAIL
Construction Period	From August 2009 to January 2012
Location	Zaventem, Belgium

Short project description

The western branch of the Diabolo project, leading to Schaarbeek, crosses the village of Haren with a new 1.12 km long viaduct, called the “Iris Viaduct”. The design of the concrete piers was based upon the symbol of the Brussels-Capital Region: the iris flower. The viaduct contains 35 spans with varying pier height to a maximum of 19.6 m. The pier heads consist of 6 three-dimensional curved slender arms, representing the petals of the flower. The arms support a concrete top plate. The pier body has a varying cross-shaped section, making the whole pier construction to be an aesthetical highly valued structure.