



Description of Structure

The structure of the passage/arcade consists of a U-shaped tunnel covered with two double-track railway bridges with a platform in between. The U-shaped tunnel (floor, walls and columns) is made of reinforced concrete. The railway bridges and the platform are constructed from pre-stressed concrete. In order to reduce the height of the construction (top of rail - bottom of deck), the railway bridges are constructed as trough bridges. A further reduction of the height is obtained by reducing the thickness of the ballast bed (with authorisation from ProRail). The platform between the two double-track trough bridges is constructed as a double T-deck. Although an integral construction was briefly investigated and seemed possible, the client preferred a more proven method of construction. Therefore, it was decided to keep the superstructure separated from the substructure by the use of elastomeric/spherical bearings.

Method of Construction

In order to reduce the number and duration of the 'out-of-operation' periods for the rail tracks, the following considerations were made:

- Use of natural foundation instead of pile foundation;
- Pre-construction of the complete structure at the site north of Tilburg Central Station (the former Nedtrain facility).

The use of a natural foundation results in differential settlements between the supports. These differential settlements do not fulfil the requirements of the client (ProRail) and result in too high stresses in the girders of the trough bridges and also in tension forces at the end supports of the trough bridges and platform.

In order to meet the requirements regarding the differential settlements and stresses, jacking of the bridges and platform is necessary immediately after positioning of the structure and a second time (1 year after positioning). For the end supports, spherical uplift load bearings are used.

By pre-constructing the entire structure, the hindrance to the rail traffic is reduced to a minimum. For the positioning of the structure in its final position, several

options have been considered. The definitive design and the tender specification are based upon the method of 'tunnel pressing in an open construction pit'.

Structural Model in Scia Engineer

The entire structure, the U-shaped tunnel, the two double-track trough bridges and the platform are modelled in Scia Engineer using Plate and Shell elements. The girders of the trough bridges are defined as subregions, with a different thickness, within the main slab. The girders of the double T-deck (platform) are modelled by using a standard ribbed plate element. Working with one overall model instead of several separate models for the individual structures, it is necessary to make sure that interaction between the different structures and structures with the subsoil is implemented correctly in the calculations.

Modelling of the natural foundation is done by using an individual surface support on the bottom slab of the U-shaped tunnel. The subgrade reaction modulus (C1z parameter) is determined by Plaxis calculations. With Scia Engineer an analysis is performed to determine the sensitivity of the structure for the range of the subgrade reaction modulus. It is concluded that the lower limit for the modulus is critical for all the main structural elements.

Using an overall model means that the bearings between the trough bridges/platform and the wall of the tunnel have to be modelled with beam elements because the use of spring elements between structural elements is not possible. The beam elements that represent the bearings were rigidly connected to the wall elements. The connection to the superstructure is modelled as a joint. Because the stiffness of the bearings in all three directions is different, a study is performed to determine the size, length and modulus of elasticity of the beam elements so they would represent the stiffness of the bearings in all directions.

The use of Scia Engineer made it possible to design this complex structure within the requirement specifications of the client.

Contact Vincent Dols
Address Beneluxweg 7
4904 SJ Oosterhout NB, The Netherlands
Phone +31 162 487000
Email vincent.dols@oranjewoud.nl
Website www.oranjewoud.nl



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Project information

Owner	ProRail
Architect	architectenbureau cepezed b.v.
Engineering Office	Ingenieursbureau Oranjewoud BV
Location	Tilburg, The Netherlands
Construction Period	05/2013 to 09/2015

Short description | New Passage / Arcade at Tilburg Railway Station

Studies show that in the coming decennia Tilburg Central Station will have to deal with a growing number of passengers and trains. In order to handle this increasing mobility, the complete station, except from the monumental covering of the station with hyperbolic shells, will be subject to a facelift. With this facelift, Tilburg will get a central station with a front and back entrance, as well as an easily accessible platform due to wide stairways, elevators and escalators. A major part in this project is the construction of a new 40 m-wide passage/arcade. The lack of space, the presence of many cables and pipes, the pollution of soil and ground water and, not least, the client's requirement that the disruption of the train traffic should be kept to an absolute minimum made this a very complex project. Oranjewoud conducted a study of possible structural concept and building methods which led to a preliminary design. After the definitive design Oranjewoud also completed the specifications for this project in December 2012. The open tender started in January 2013.

