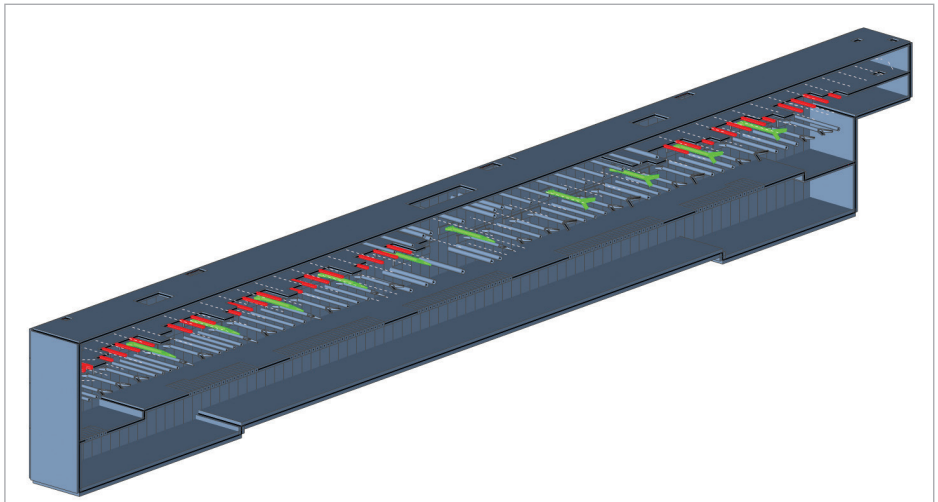
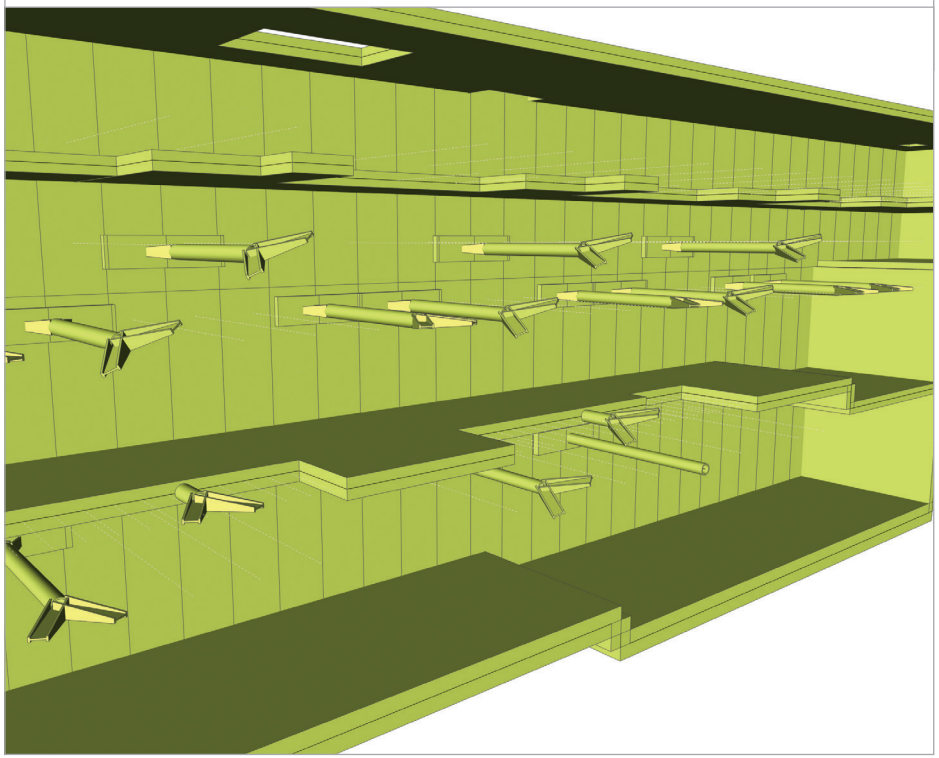
Ceintuurbaan Station, North/South Metro Line - Amsterdam, The Netherlands





Software: Scia Engineer

Project description

Ceintuurbaan Station is part of the North/South line project, situated in the historic centre of Amsterdam. The scope of the project contains eight stations and connects the northern and southern districts with the city centre.

The metro line measures approximately 10 km in length, divided into an underground section of 7 km and a bored tunnel of 3 km long. The metro line runs from the above-ground Buikslotermeerplein Station via a semi-sunken route and is connected with the Central Station by an immersed tunnel below the IJmeer. From the Central Station, the metro line continues its route via the stations Rokin, Vijzelgracht and Ceintuurbaan. These stations are all constructed at an average depth of 30 m below the surface and are connected by a bored tunnel. At Europaplein Station the metro arrives above the ground and is connected to the existing metro network at Zuid/WTC Station.

Structure and building method

Ceintuurbaan Station is 230 m long and has an average width of 11 m. Due to the limited space available between the buildings at street level, the station is designed for two bored tunnels, which are located above each other. The station has two main entrances through which passengers can enter the station at NAP +0.6 m.
From the concourse level at NAP -6.8 m, passengers (approximately 42,500 a day) are divided over the two lower platforms by an escalator or elevator.

To minimise the duration of the impact on traffic and the surroundings, the station is built by using the cut & cover method. First, the diaphragm walls, 1.2 m thick, and the roof were made. Below the roof structure more excavation took place, while constructing several floors and metro platforms. To guarantee the vertical stability of the deepest section, the last couple of metres were excavated under compressed air, starting from the intermediate floor at NAP -18.8 m. After the completion of the foundation slab, the concrete structure was ready to be connected with the bored tunnels.

Horizontal stability of the structure

During the excavation process, the diaphragm walls were supported by temporary steel struts at different levels to secure horizontal stability. Due to its great depth and the presence of several openings in the floor slabs, the combination of diaphragm and retention walls also has to be supported by additional struts in the final phase. These struts are applied at five different levels.

The permanent steel struts are installed and prestressed in the presence of the temporary steel struts and floor slabs. The temporary steel struts are removed in different phases. During removal, the deflection of the steel struts is monitored by strain gauges and extensometers. With the information obtained from these measuring instruments, the forces per construction stage can be determined.

Use of Scia Engineer

To verify these results, a 3D model of the station is created in Scia Engineer. With the use of the module ‘construction stages’, the influence of the several construction phases could be predicted. This gave the opportunity to verify the retrieved information from the monitoring. Furthermore, the model made it possible to anticipate critical situations and to prevent the forces from exceeding the design values in the consecutive stages.

Witteveen+Bos

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Witteveen+Bos was founded in 1946 by the engineers G.S. Bos and W.G. Witteveen. At the present time, the company comprises eight offices in the Netherlands and eight international offices and has more than 900 employees. Today, Witteveen+Bos is among the top 10 engineering firms in the Netherlands.

The company offers clients value-added consultancy and top-quality designs for water, infrastructure, environmental and construction projects. We deliver reliable solutions based on knowledge, experience and social insight. In an inspiring working environment, we take on fascinating challenges, while ensuring our core values of expertise, reliability and commitment.

Besides the offices in the Netherlands, Witteveen+Bos is also located in Indonesia, Kazakhstan, Latvia, Russia, Belgium, and Vietnam. Furthermore, the company is a member of the Strategic European Expertise Network (SEEN) and takes part in several strategic alliances.

Project information

Owner	The city of Amsterdam
Architect	Benthem Crouwel Architects, Amsterdam
General Contractor	The city of Amsterdam
Engineering Office	Consulting firm Noord-/Zuidlijn
Location	Amsterdam, The Netherlands
Construction Period	2003 to 2017

Short description | **Ceintuurbaan Station, North/South Metro Line**

With its length of 230 m, depth of 30 m and average width of 11 m, Ceintuurbaan is the narrowest station of the North/South line. Its great depth made it necessary to support the combination of diaphragm and retention walls in both the construction and final phases. Therefore, permanent steel struts are installed and prestressed. These struts are designed to bear the horizontal loads and minimise the deflection of the walls during the operational phase. The 3D model made it possible to analyse the behavior of the structure in the construction stages and to anticipate critical situations.