Civil Engineering & Infra

Field of expertise: Immersion tunnels & constructions
Client: Joint Venture Züblin / Boskalis

Project scoped

In this project, MH Poly has used his expertise to advice on immersion related matters. Considering the challenging boundaries in this project, MH Poly has also been using his broad knowledge to immerse the tunnel elements in the most effective manner without exceeding the client's restrictions. During the tender phase MH Poly also indicated the interfaces between the immersed tunnel and other (temporary and permanent) constructions.

Project activities

- Design Basis for immersion of the tunnel elements.
- Preliminary design and detailed design on immersion engineering items such as: immersion pontoon, access shaft, bulkheads, anchor points, sandflow system and a closing seal between the immersed tunnel part and the cut and cover.
- Advice on immersion and construction sequence of the immersed tunnel
- Illustration of the immersed tunnel both in 2D and 3D.
- On site consultancy during the immersion operations.

mhpoly
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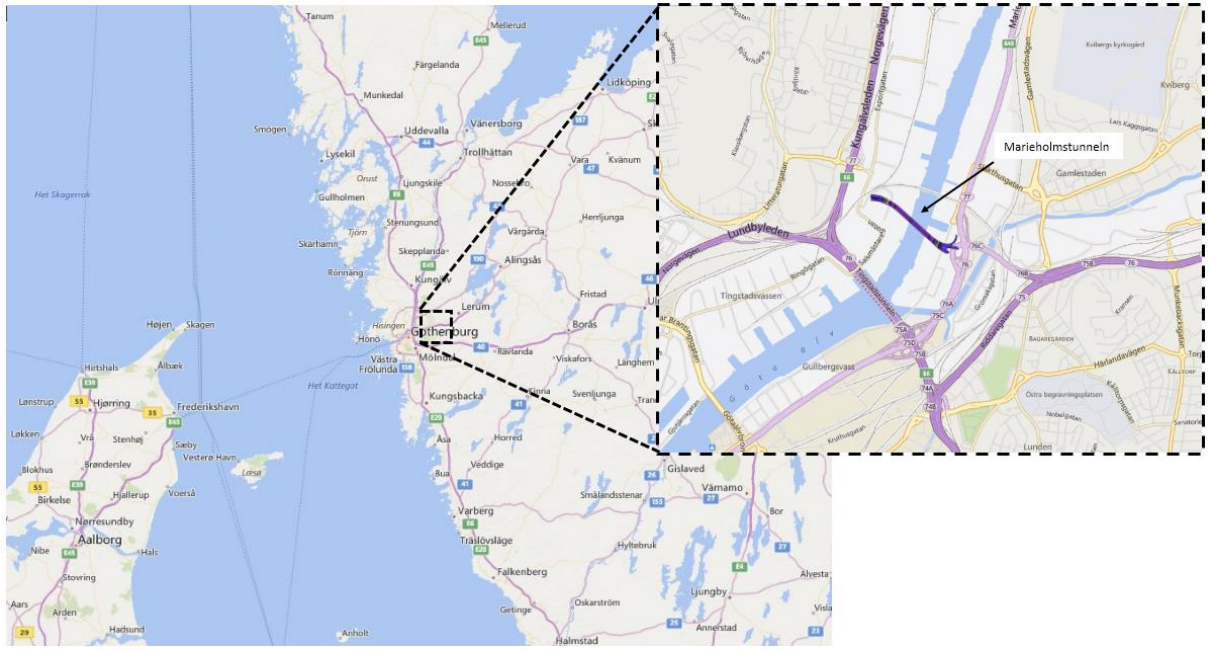
Marieholm Tunnel Göteborg
'A design for immersion of the tunnel elements'



Project description

The project 'Marieholmstunneln', situated in Göteborg, is an approximately 500 meter long immersed tunnel project, which includes a cut-and-cover part at both the Tingstad and Marieholm side of the river. This project is part of a connection project of Trafikverket, The Swedish Transport Administration. The tunnel is designed for a traffic flow of 90.000 vehicles per day; three traffic lanes will be constructed in each direction. The construction started in 2014 and is planned to finish in 2020. At this moment the cut & covers are being constructed.

For MH Poly the project started in 2013 by advising in the tender phase. After winning of the tender, by the Joint venture Zublin Boskalis, MH Poly has been involved in basic and executional design of the temporary constructions which are needed for immersion of three tunnel elements. MH Poly was involved during the immersion process by on-site supporting the immersion team.

Top layer: 0,5 – 2,0 m fill material/dry crust clay

Main layer: 60m – 100m soft clay, slightly overconsolidated OCR = 1,25

Granular layer: 0 – 15 m overlaying rock

Inom Göta älv		Tingstad samt Marieholm	
Nivå	$C_u^{direkt\ skjuvning}$ (kPa)	Nivå	$C_u^{direkt\ skjuvning}$ (kPa)
+10	5	+10	12
+8	8	+8	12
-16	44	-16	44
-27	56	-27	56
-65	113	-65	113

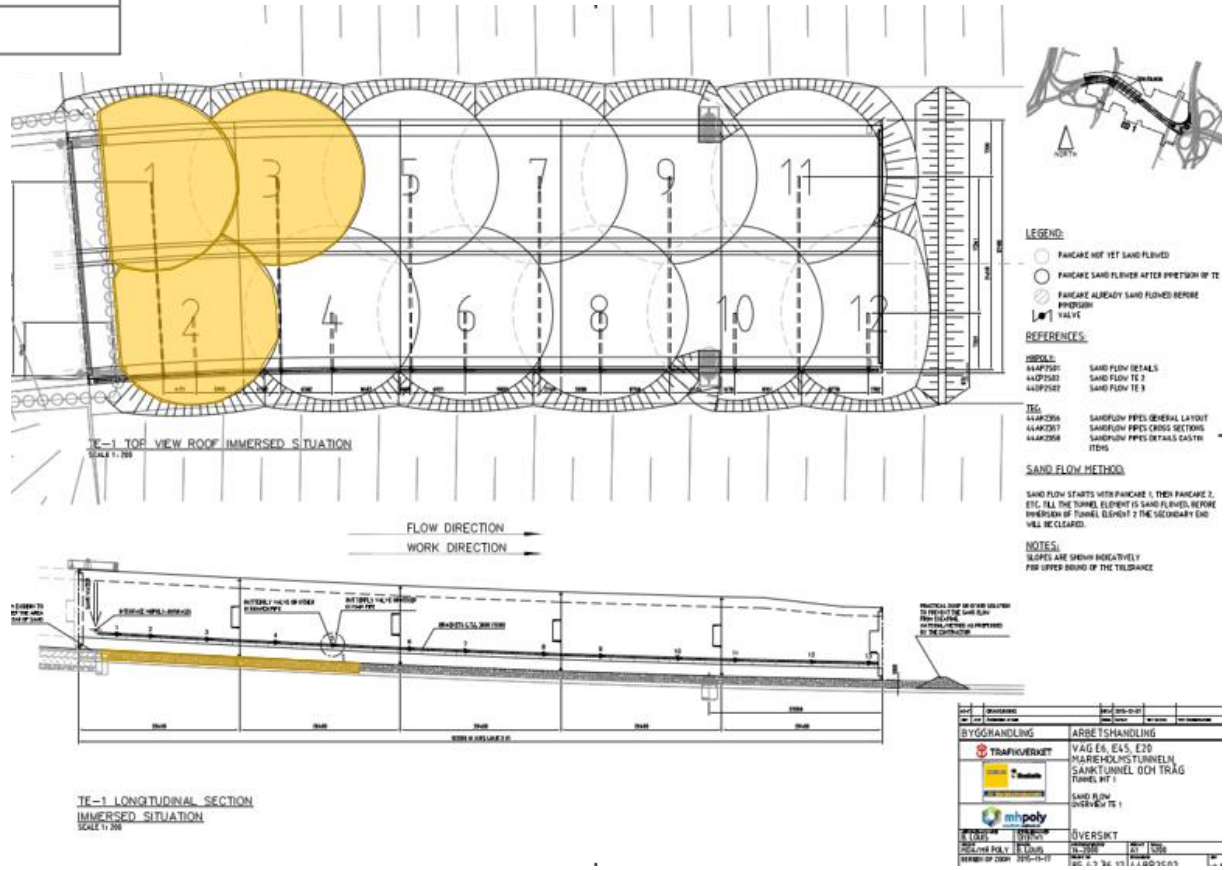
Soil conditions

One of the challenges in the project is the presence of soft clay with the maximum layer thickness of 100 meter. This soft characteristics resulted in an extraordinary design of the temporary supports. The immersion joints were affected as well.

Tunnel foundation

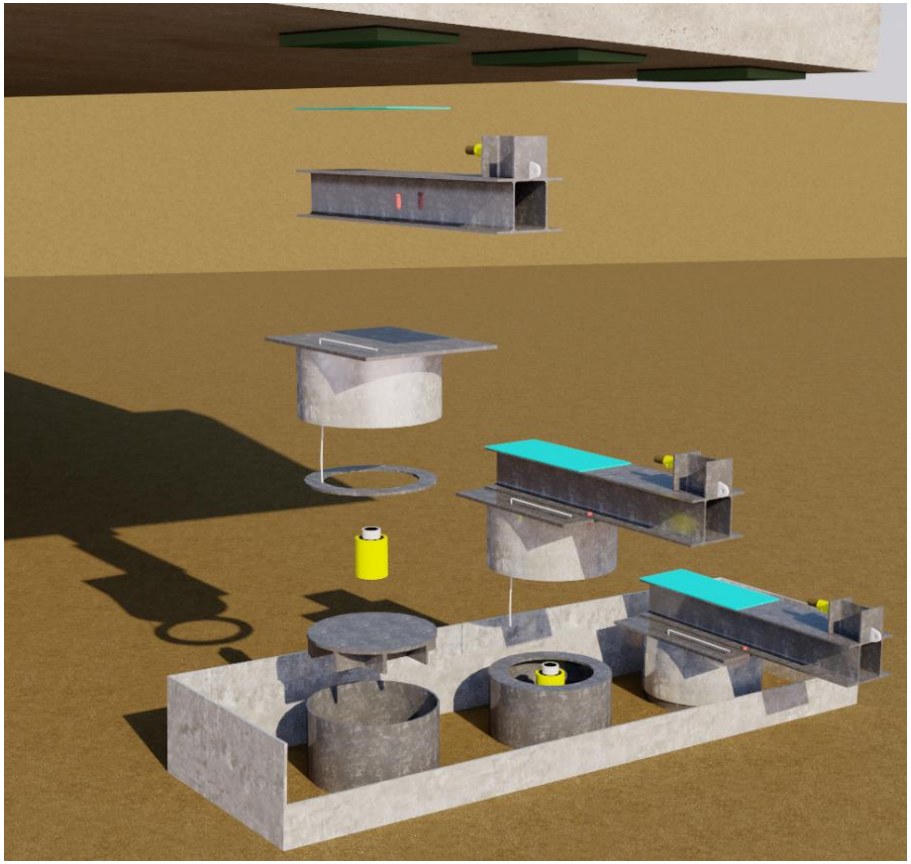
The foundation method of the immersed elements is the conventional sand flow method. The sand flow usually consists of a 1 meter thick sand layer which is pumped from a storage area, usually located on shore, through a pipe line to the outflow points underneath the tunnel element. In this project the measurements carried out during the immersion and the sandflow process were quite remarkable. All these measurement were needed in order to meet the challenging boundary conditions during the design and construction stages.

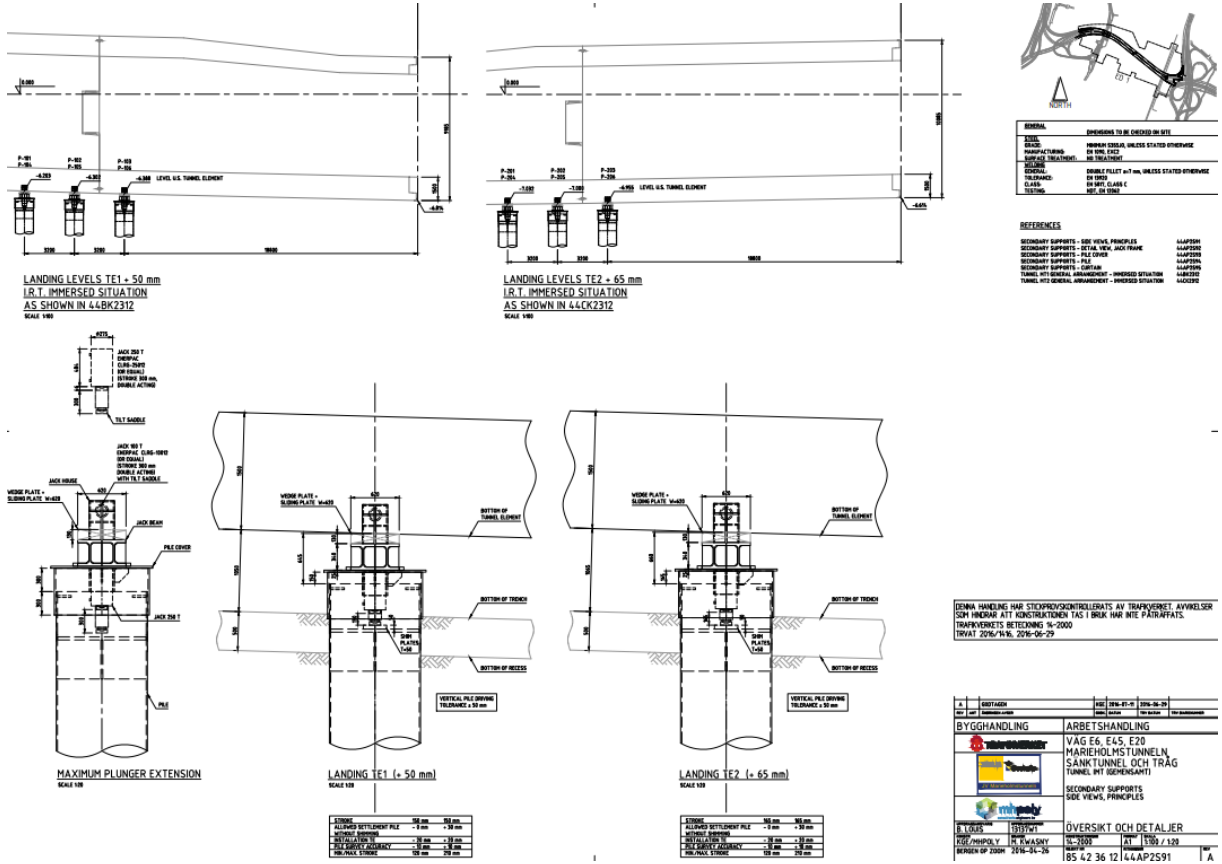
First, it was important to measure the salinity of the immersion trench as a small salinity variation has a large impact on the exerted loads on the temporary supports. Second, the (uplift) loads due to the sandflow were predicted by measuring several important values in the pipe line. Third, the pressure on the temporary supports were measured constantly.

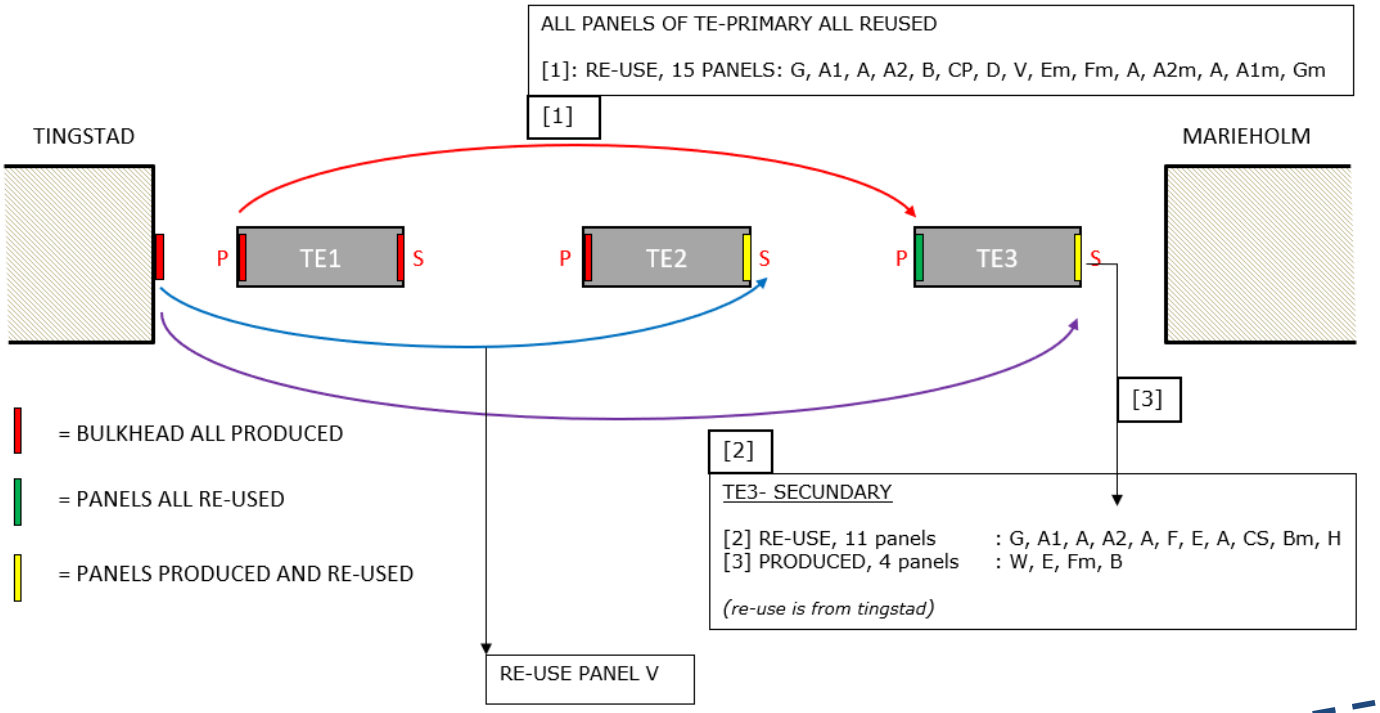


Temporary supports

In order to be able to install the sand foundation the tunnel element needs to be immersed on the temporary supports leaving a gap between the underside of the element and the soil. Conventionally, the temporary (secondary) supports consist of concrete foundation pads located at the secondary side of the tunnel element. Due to the soft clay it was not possible to use this solution. Instead the secondary support has been executed as a piled foundation, where one support point consists of three piles. In order to make the temporary supports work MH Poly has designed a system that acts as one support. The same support points have been used as a aligning system for both the horizontal and the vertical direction. During the immersion process the temporary supports were constantly monitored. As soon as the sandflow process is completed the tunnel element can be released on the sand foundation.

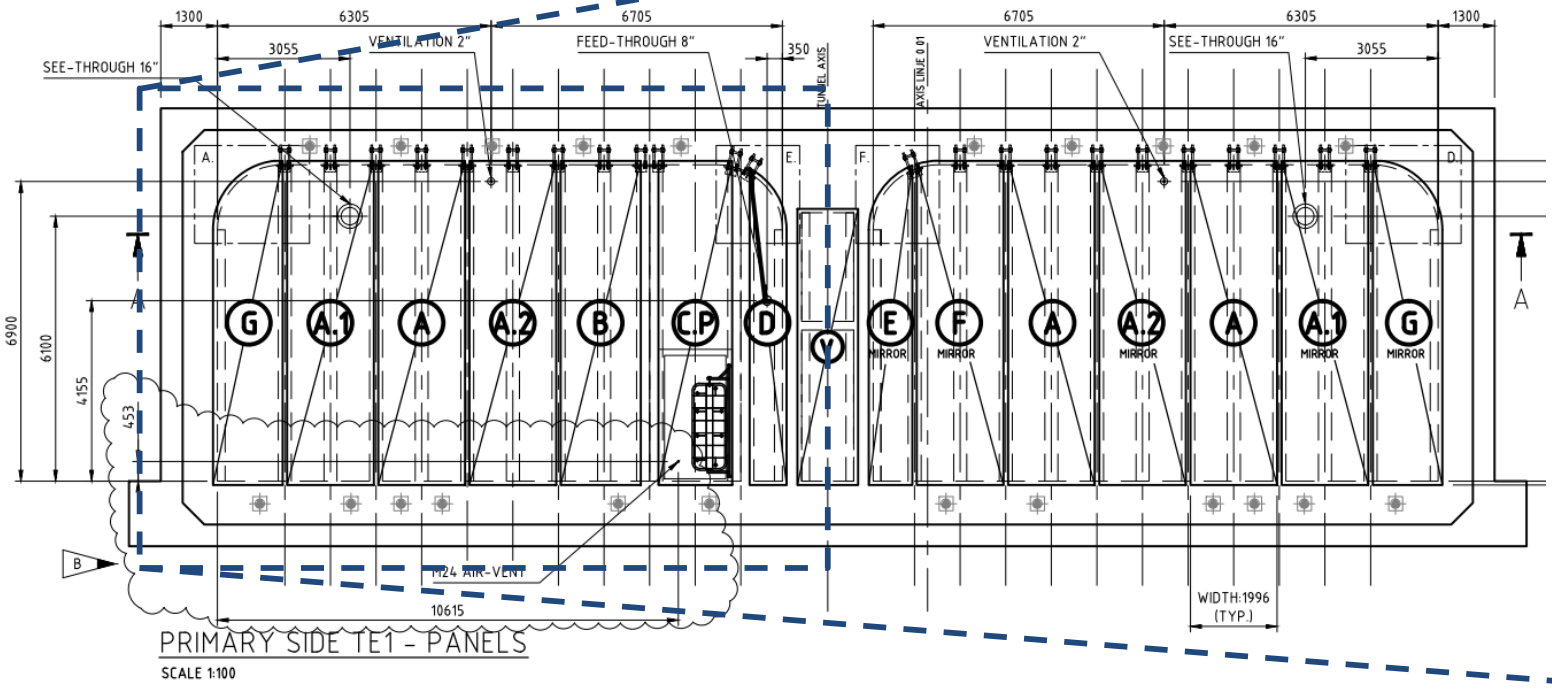






Bulkheads

It is worth mentioning that the bulkheads, which make floating of the tunnel elements possible, were designed in such a way that they were easy to remove from the tunnel elements and to reuse them. The first tunnel element were immersed long before the last element were constructed. After the immersion of the second tunnel element the bulkheads of the first tunnel element were used for immersion of the last tunnel element.

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