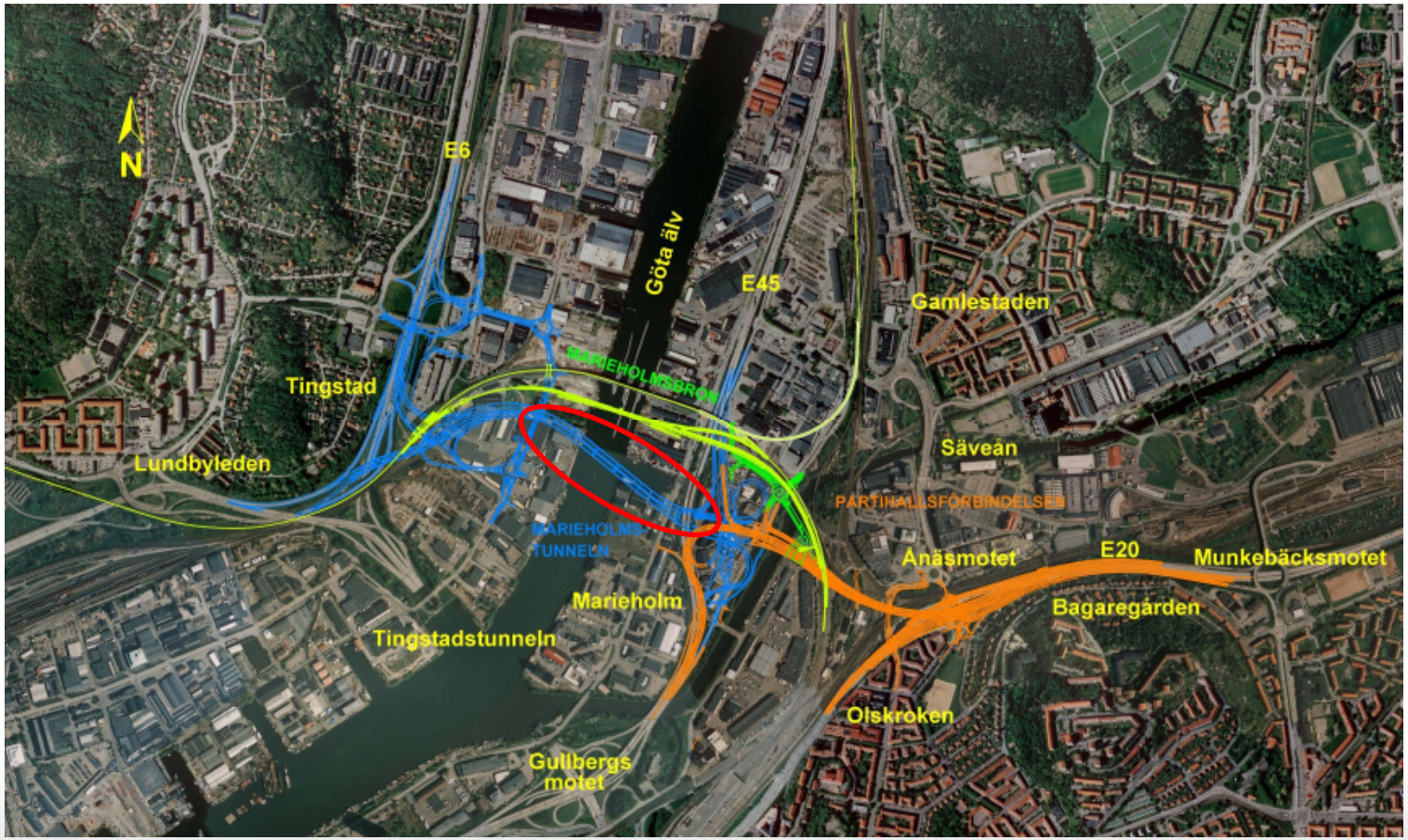
PÅLDAG 15, Göteborg, 21.05.2015

Marieholmstunneln – stödkönstruktion vid älven

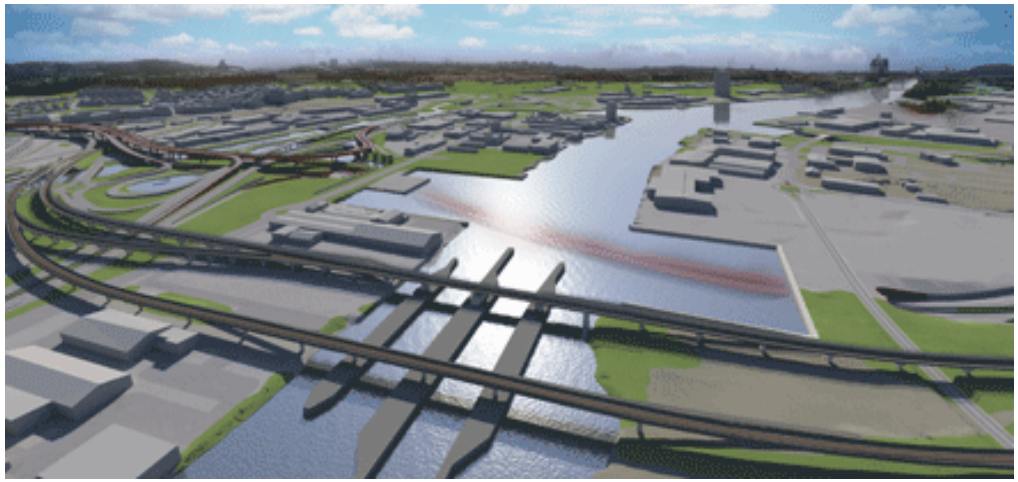
Dipl.-Ing. Johannes Glückert, technical manager

Dr.-Ing. Christiane Hof, design manager

Marieholmstunneln – del av Marieholmsförbindelse



Marieholmstunneln – del av Marieholmsförbindelse



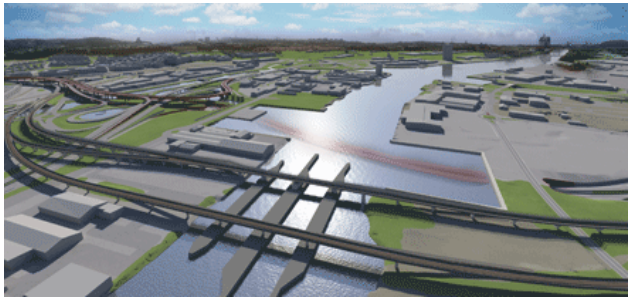
Client TRAFIKVERKET

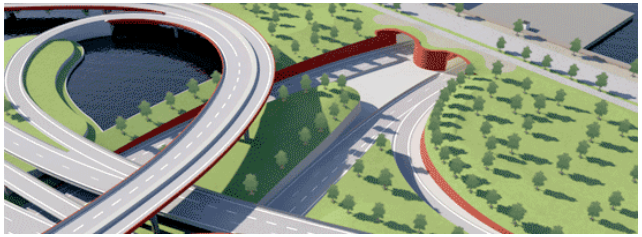
Contractor ZÜBLIN Boskalis JV Marieholmstunneln

- Design and Build contract
- Contract amount SEK 1 533 499 000
- Construction time 06/2014 – 10/2020

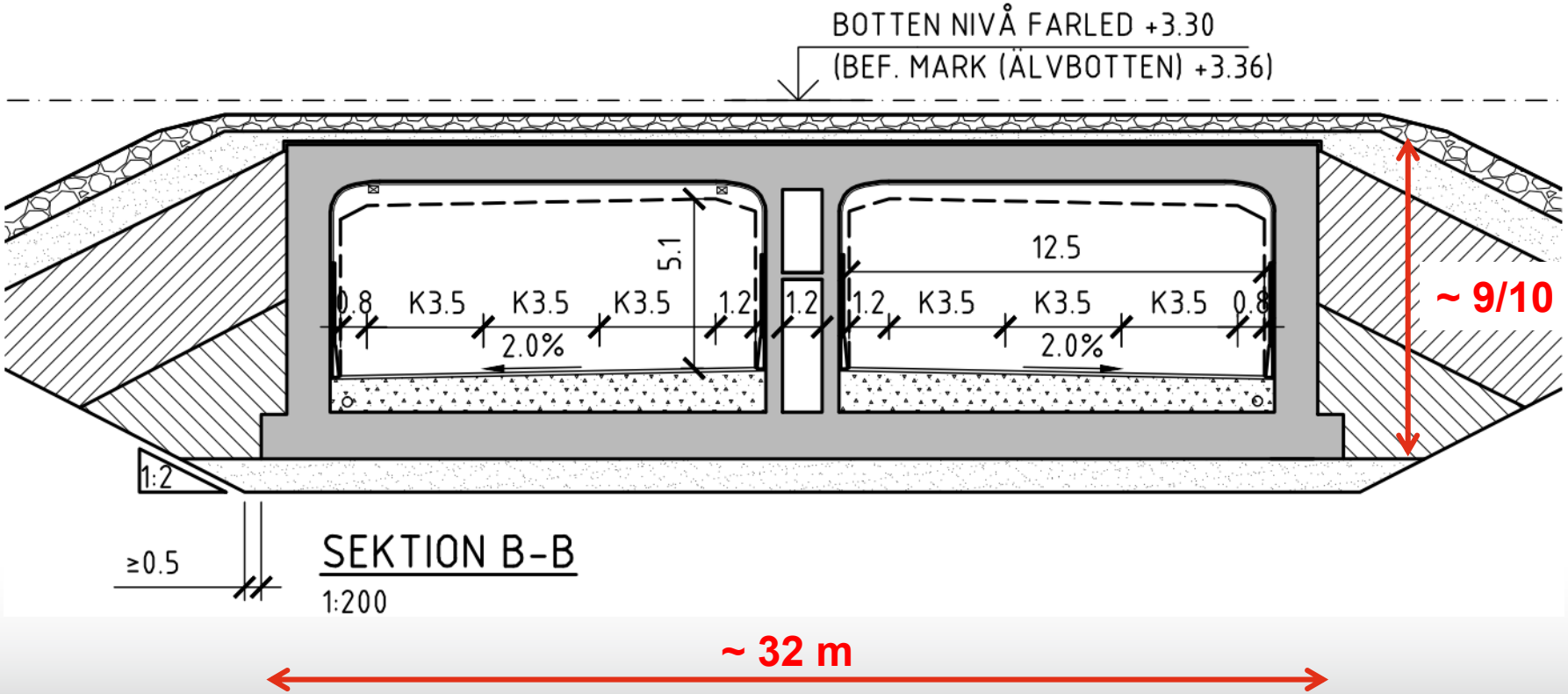
Marieholmstunneln – del av Marieholmsförbindelse

- Dimensioned for 90 000 vehicles per day
- Three lanes in each direction
- Length 500 m
- Traffic connections on both sides of the tunnel

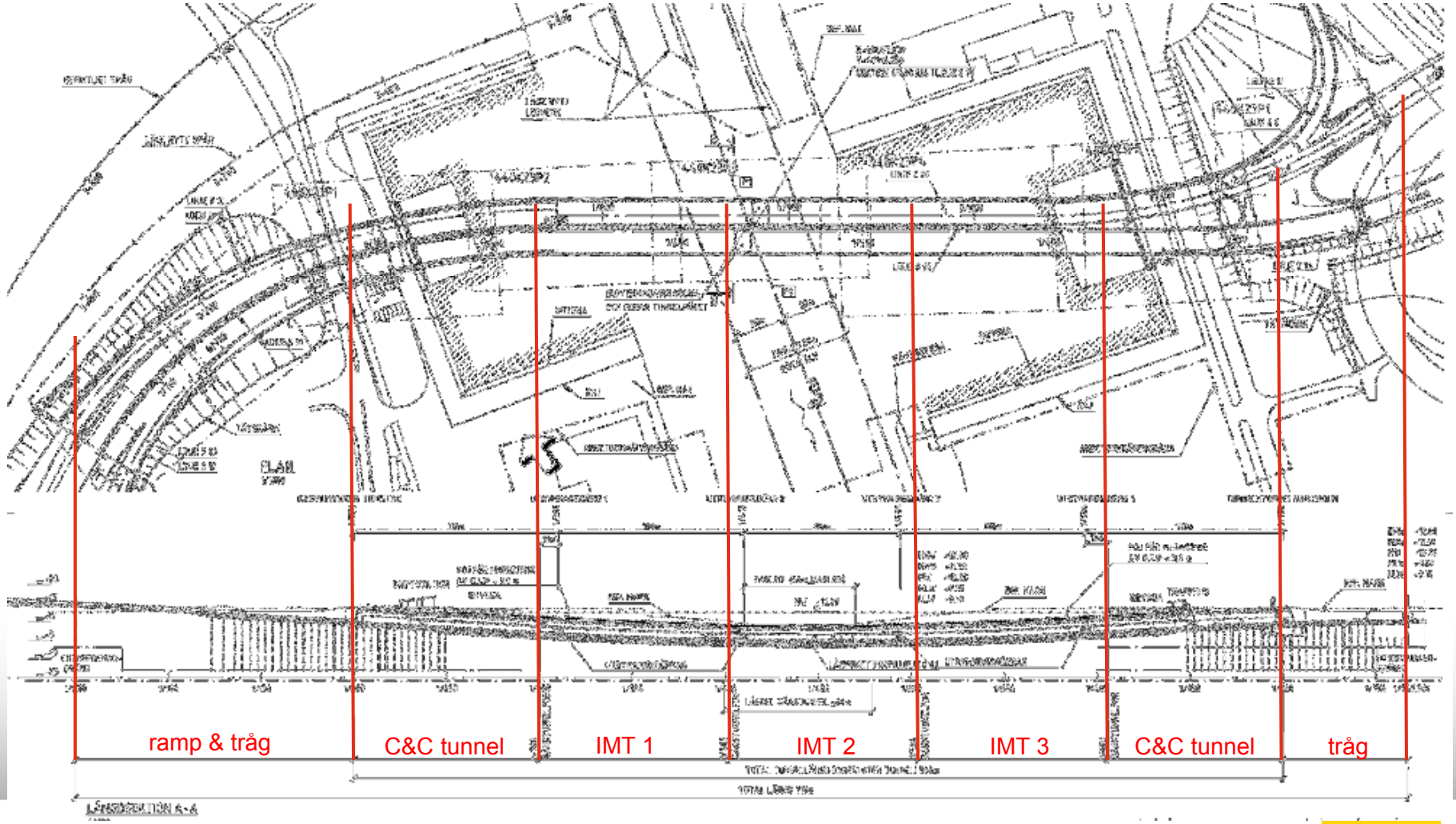




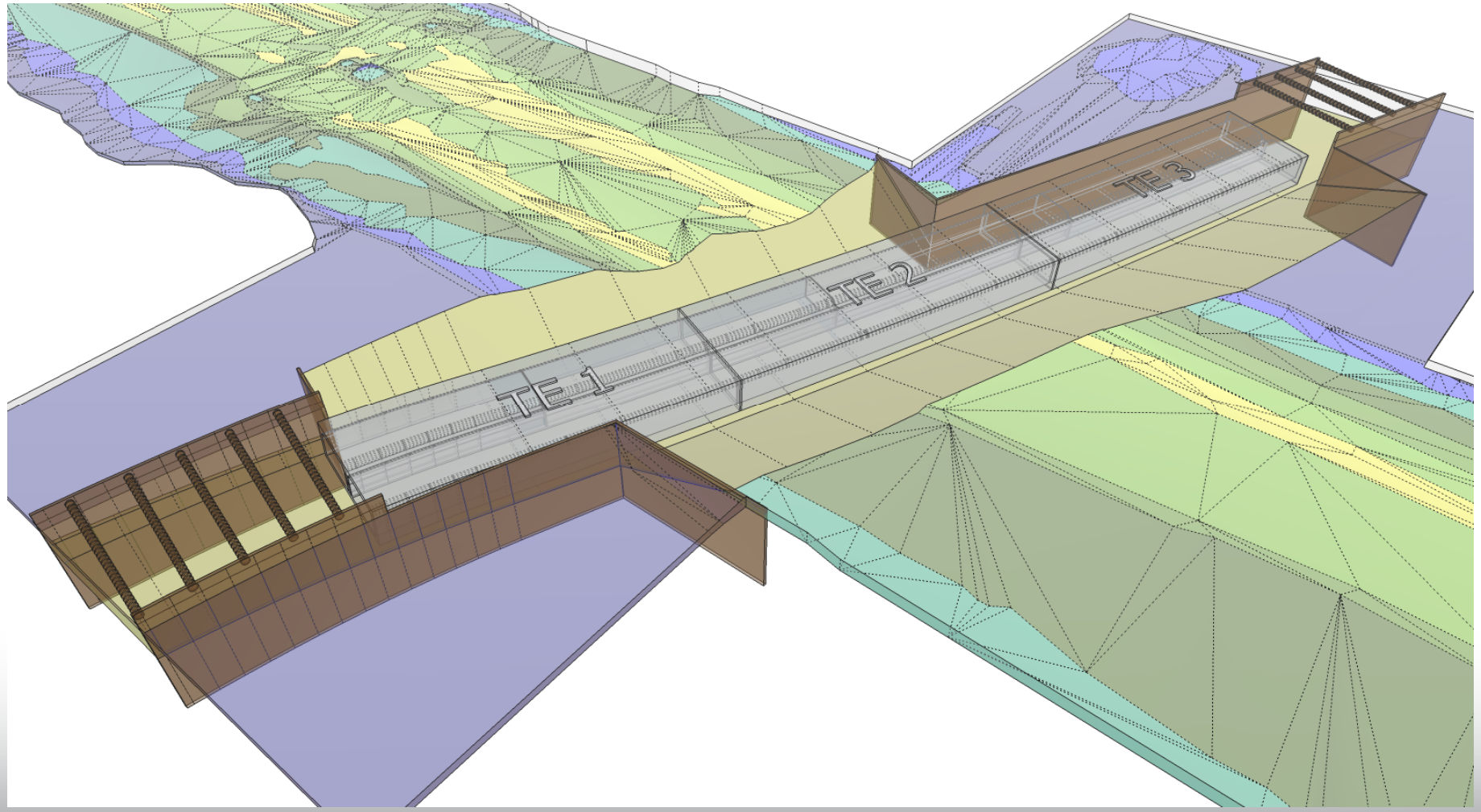
Marieholmstunneln overview



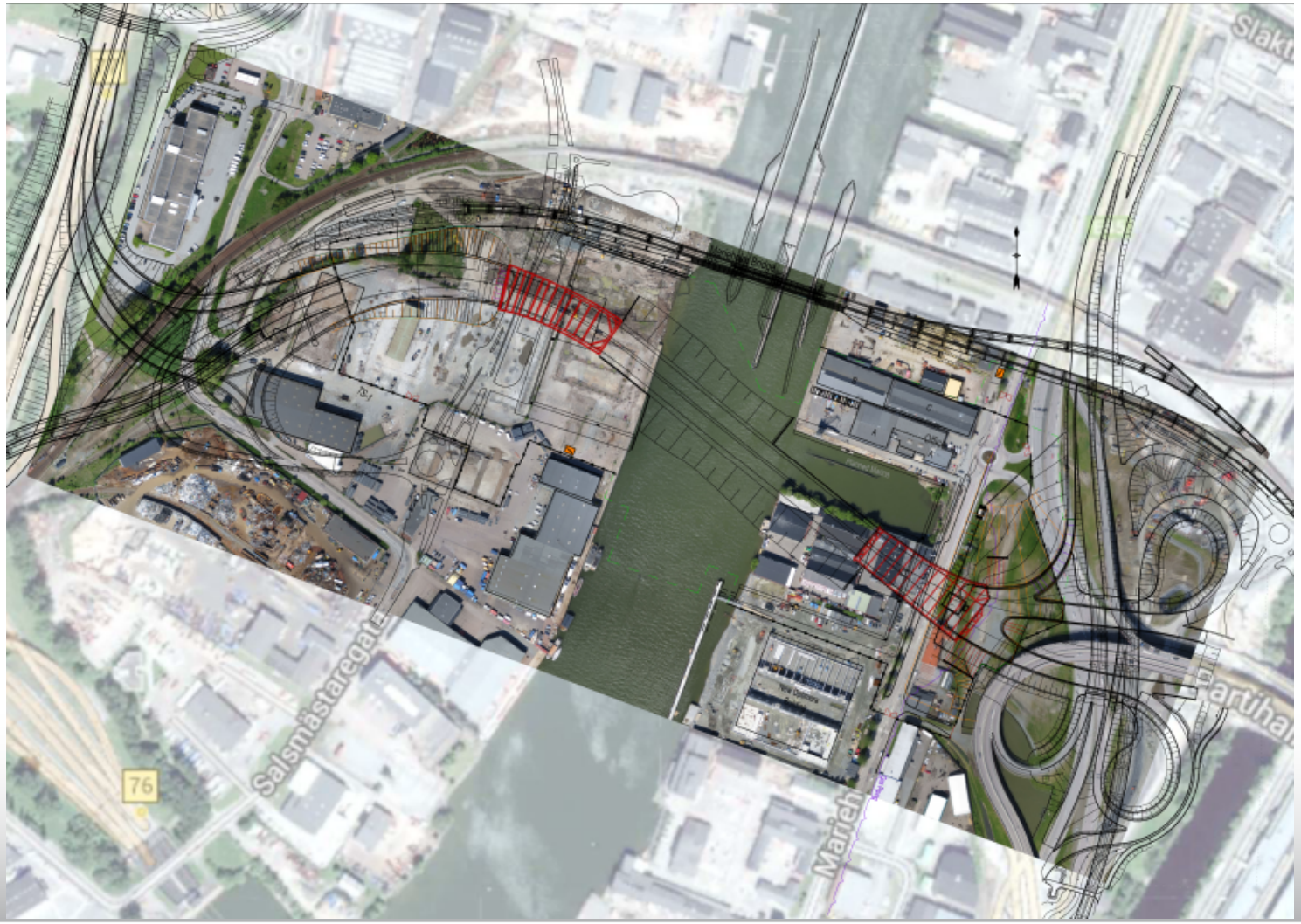
Marieholmstunneln overview



Immersed tunnel and Cut & Cover



Temporary works



Soil conditions

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

Design Drydock

General concept:

- *Wet excavation*
- *Stiff retaining wall* in form of pipe-to-pipe wall
- *2 strut levels*:
  - Top strut level above surface
  - Bottom strut level partly installed under wet conditions:

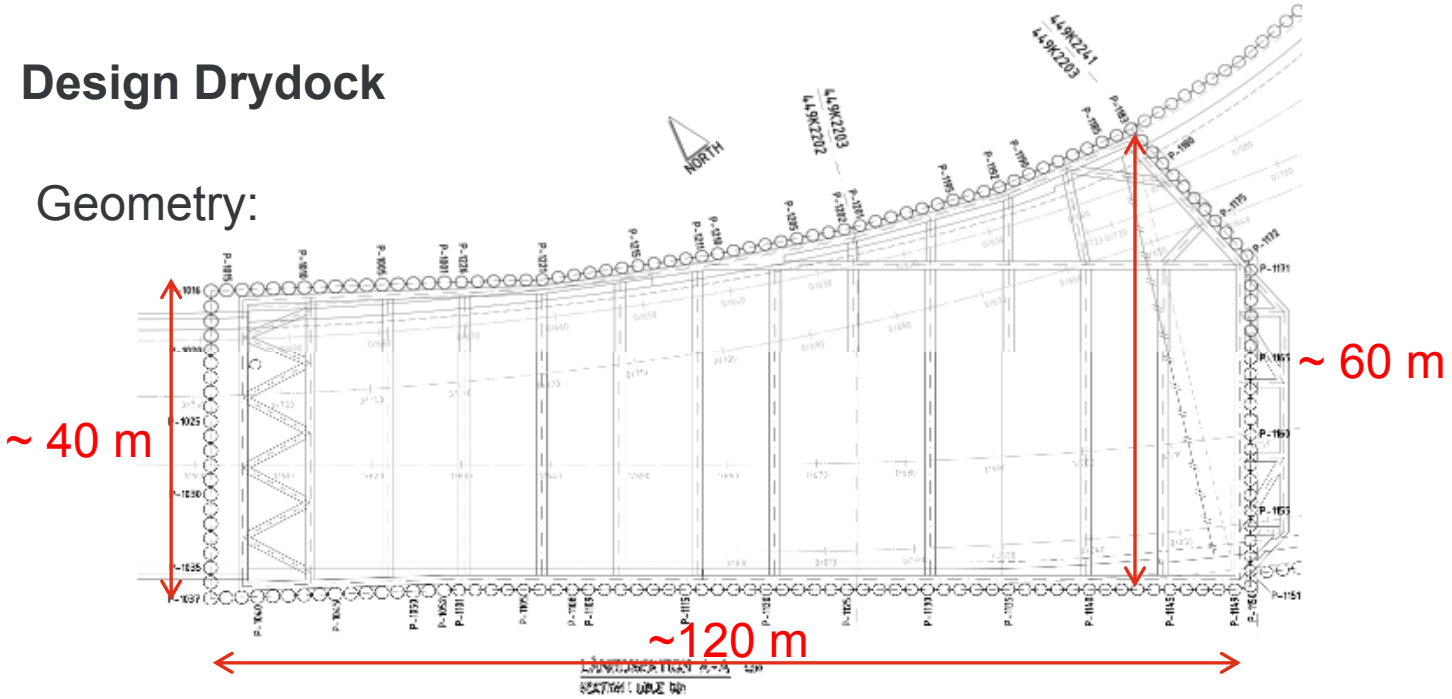
    drainage layer: no built up of water pressure

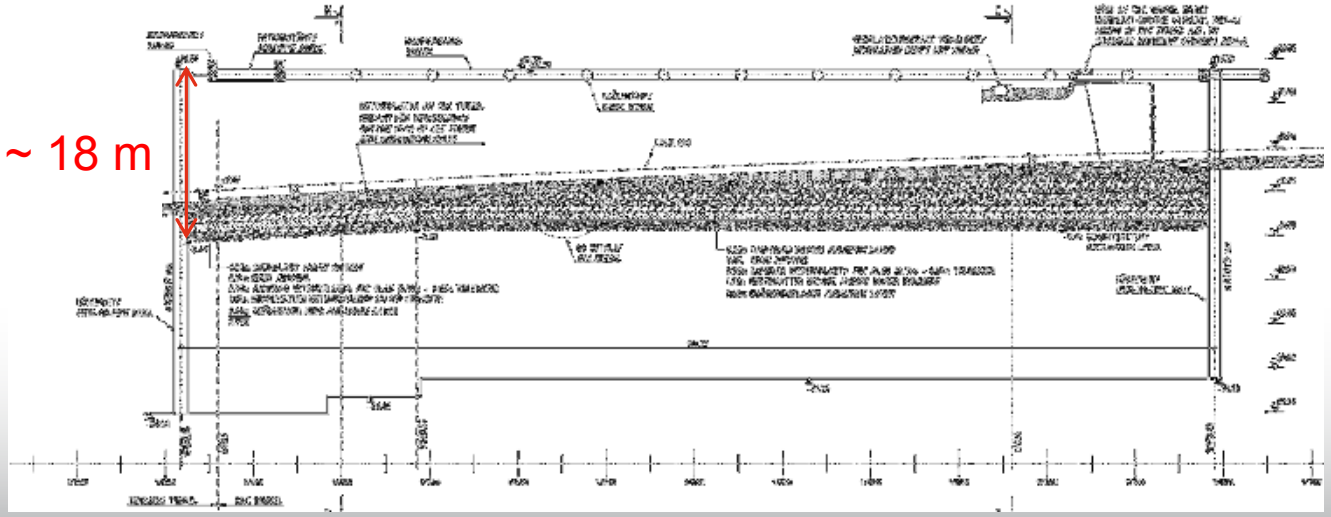
    underwater concrete slab: short term, only normal forces

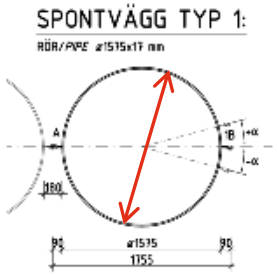
    reinforced concrete slab: longterm, bending due to heave
- *Monitoring*

Design Drydock

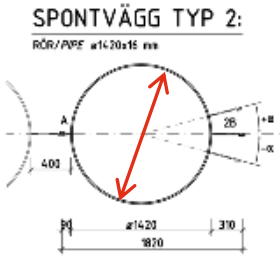
Geometry:







1575 mm
t =18 mm



1420 mm
t =16 mm

Design Drydock

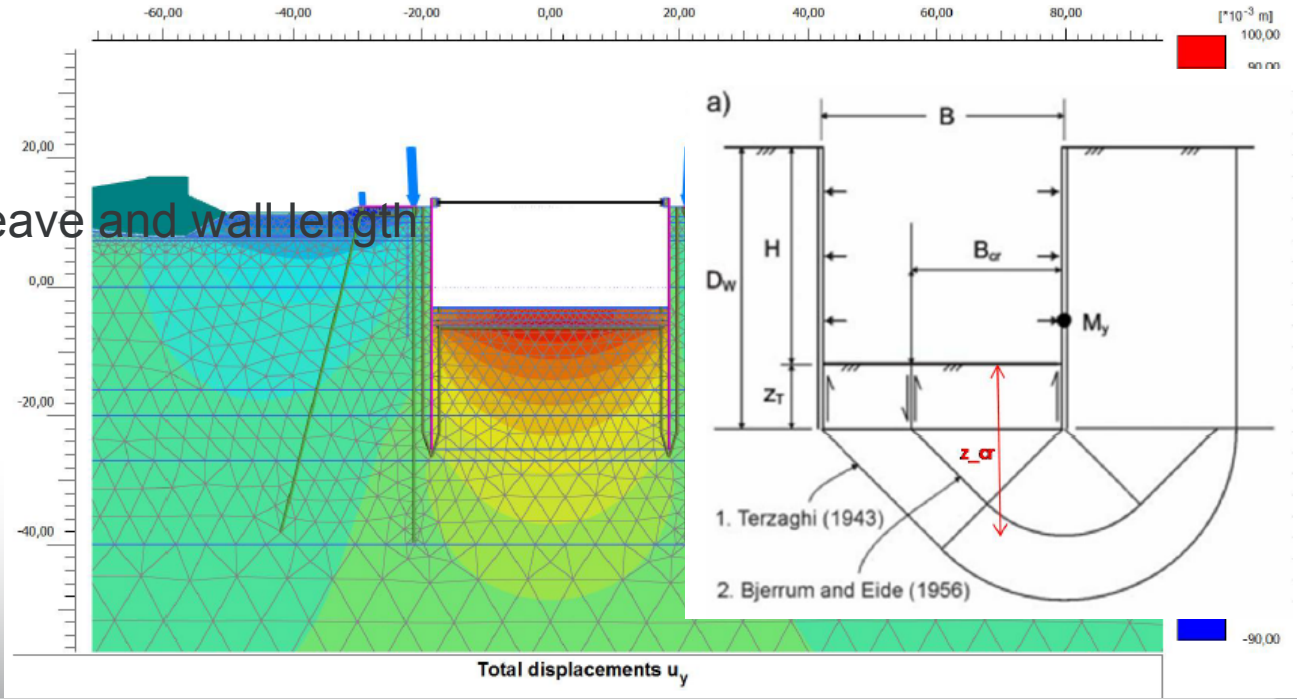
FEM calculation with Plaxis

Soil model: Hardening Soil small strain (HSss), undrained A

Consolidation time for different working steps is implemented to calculate the time depending heave

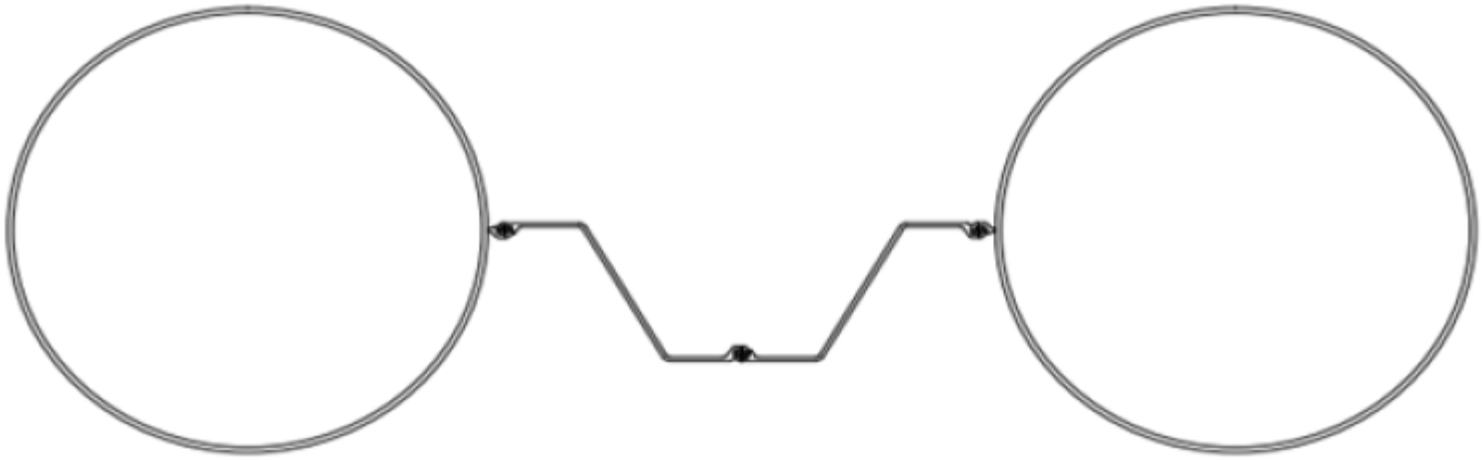
Additional

Overall stability: base heave and wall length with analytical check



Design Drydock: Pipe-to-pipe wall versus Combiwall

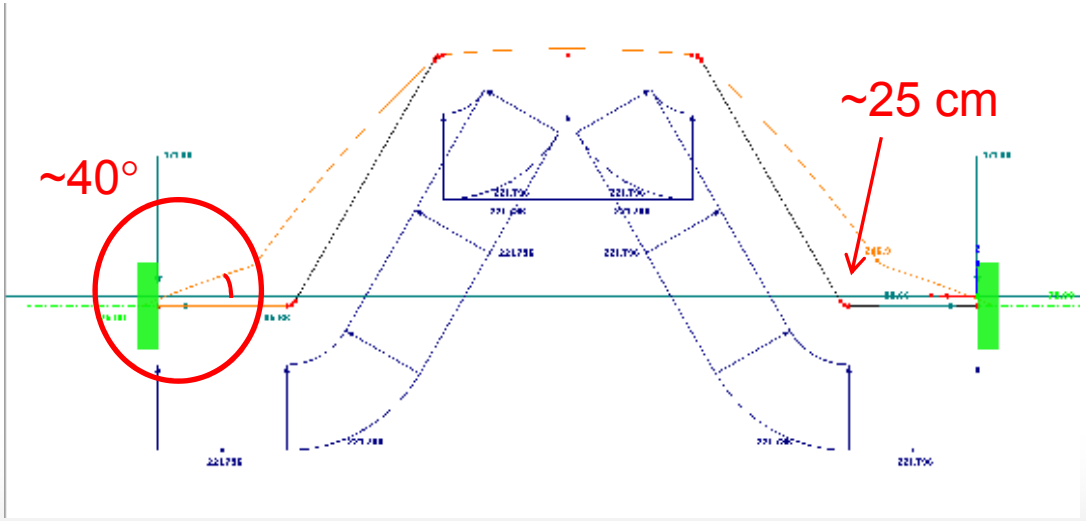
Typical Combiwall:



Design Drydock: Pipe-to-pipe wall versus Combiwall

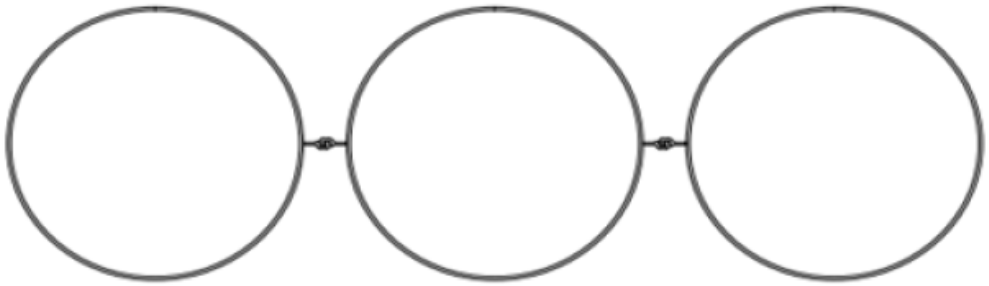
Problem with Combiwall: infilling sheet pile

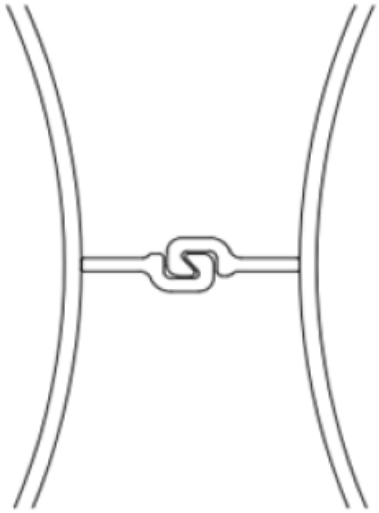
Earth pressure +
installation tolerance at 18 m depth → Large deformations



Design Drydock: Pipe-to-pipe wall versus Combiwall

Typical Pipe-to-Pipe-Wall:

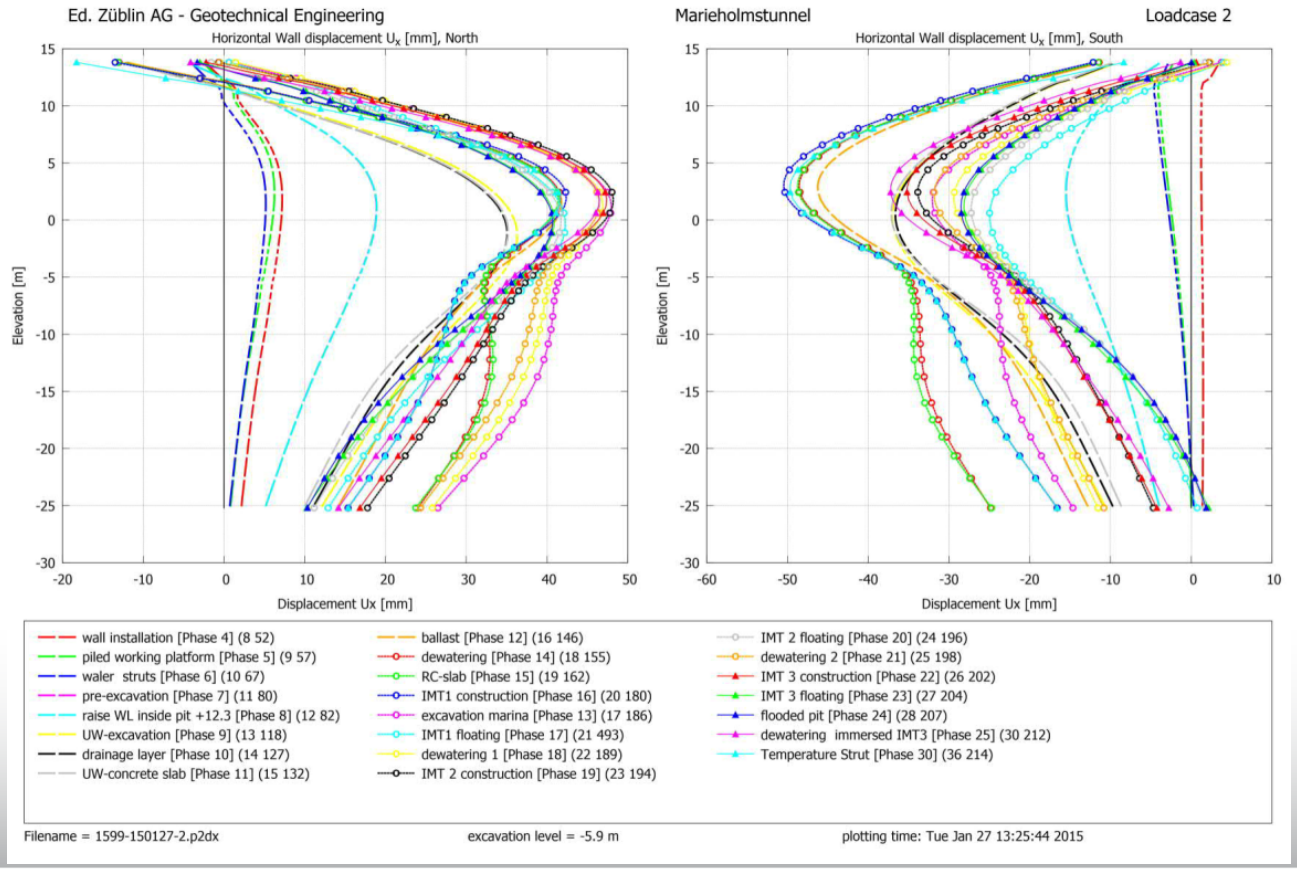




Design Drydock: Pipe-to-pipe wall versus Combiwall

Advantage of pipe wall:

- Less deformation: horizontal max ~50 mm

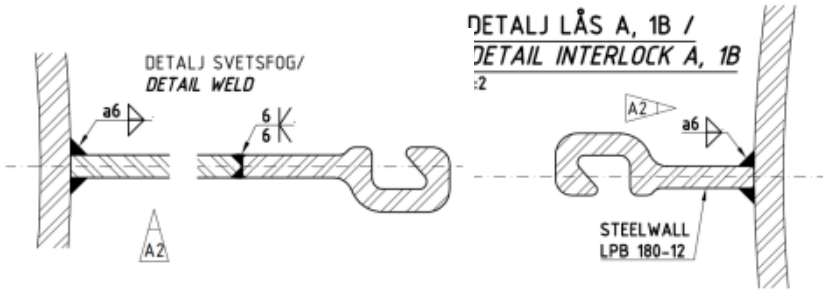


Design Drydock: Pipe-to-pipe wall versus Combiwall

Advantage of pipe wall:

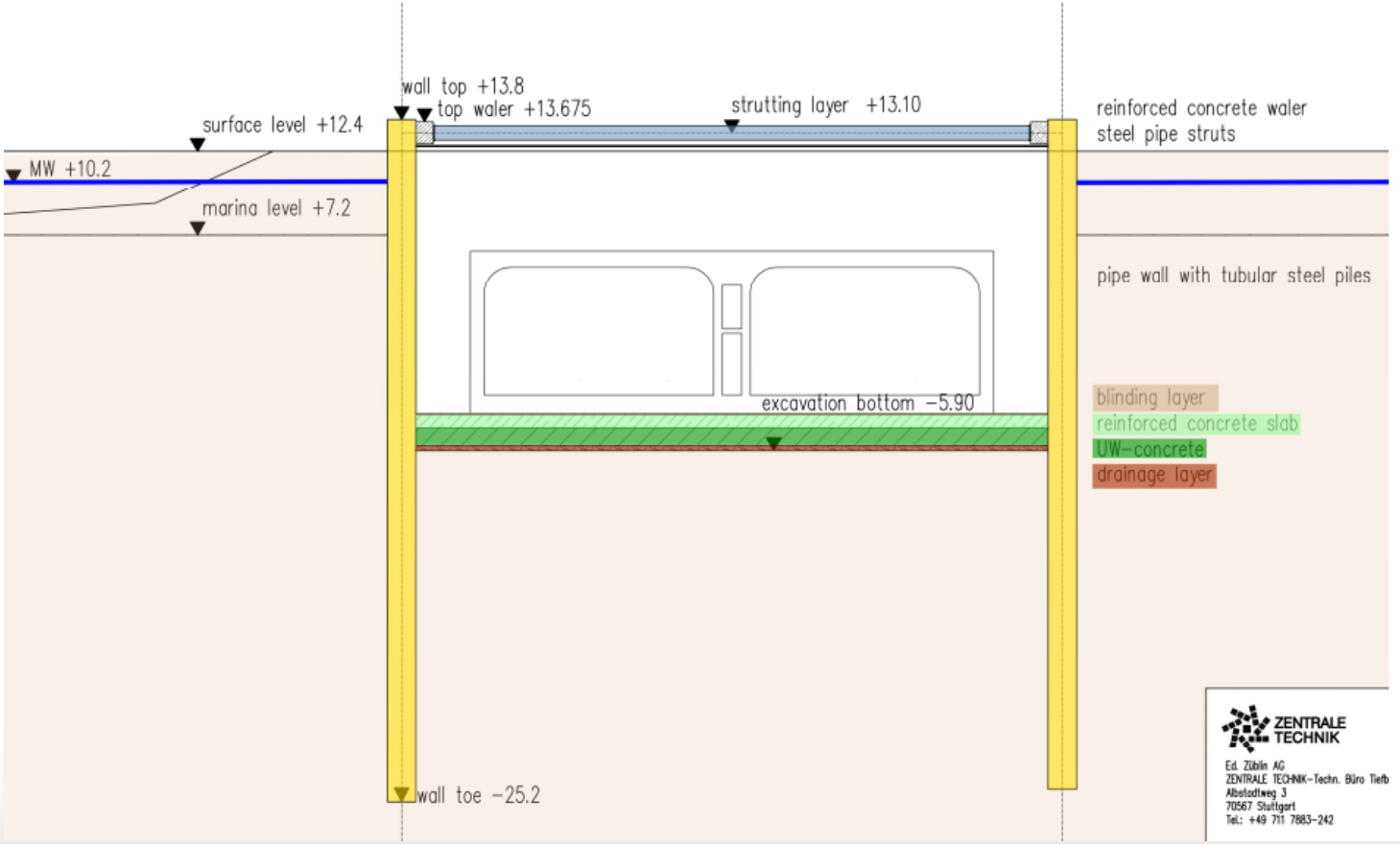
- Less deformation: horizontal max ~50 mm
- Locks only for sealing and guiding, no structural function

Standardlock LPB 180-12



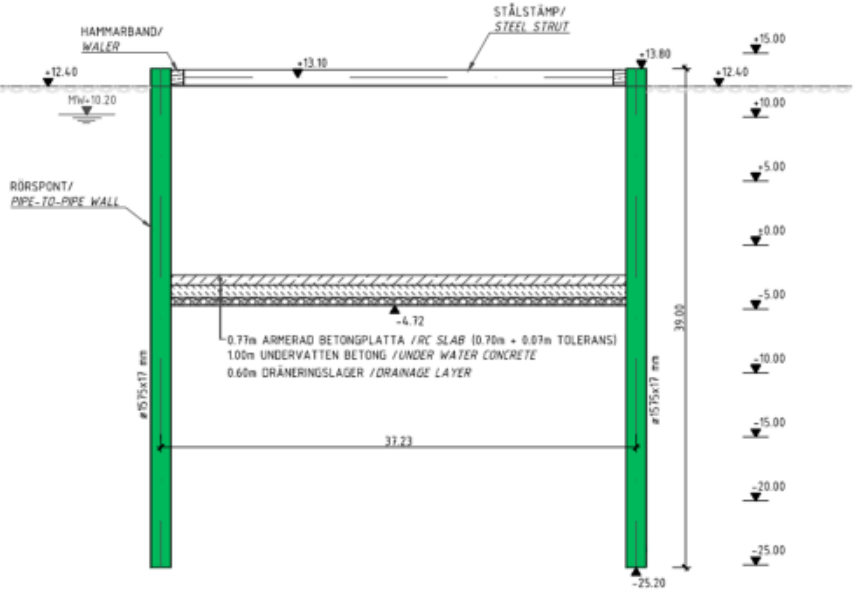
Lock sealing

Typical cross section



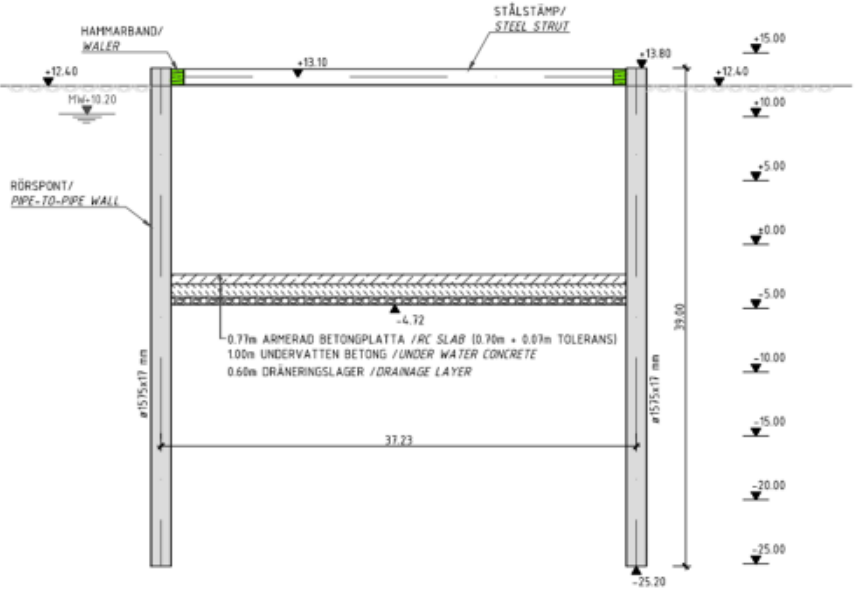
Working sequence

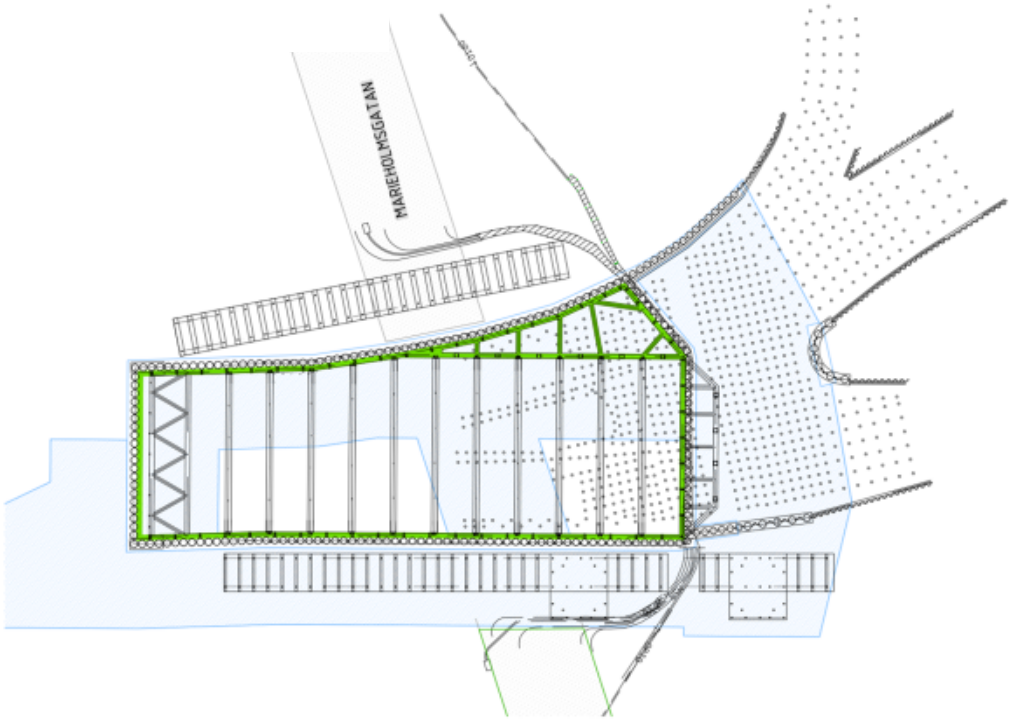
1. Installation of pipe wall



Working sequence

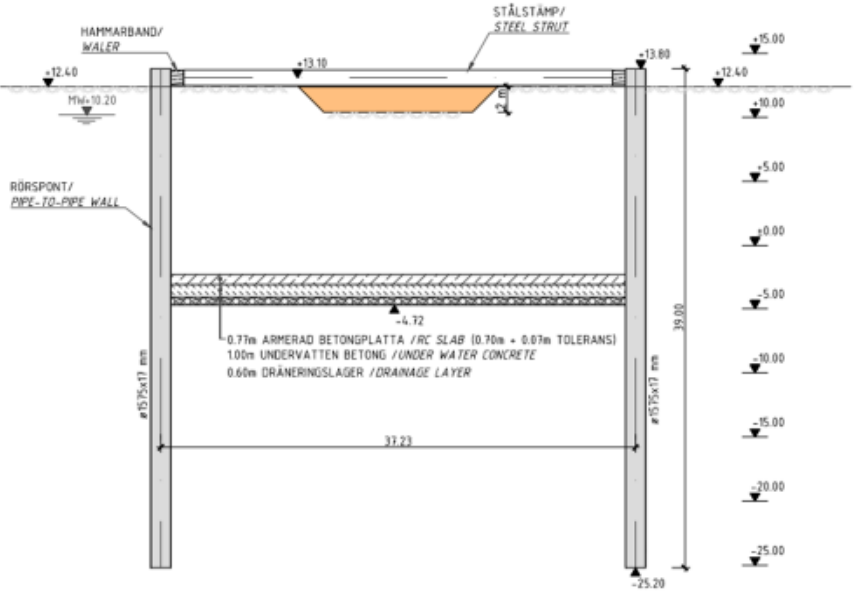
2. Installation of concrete and steel waler

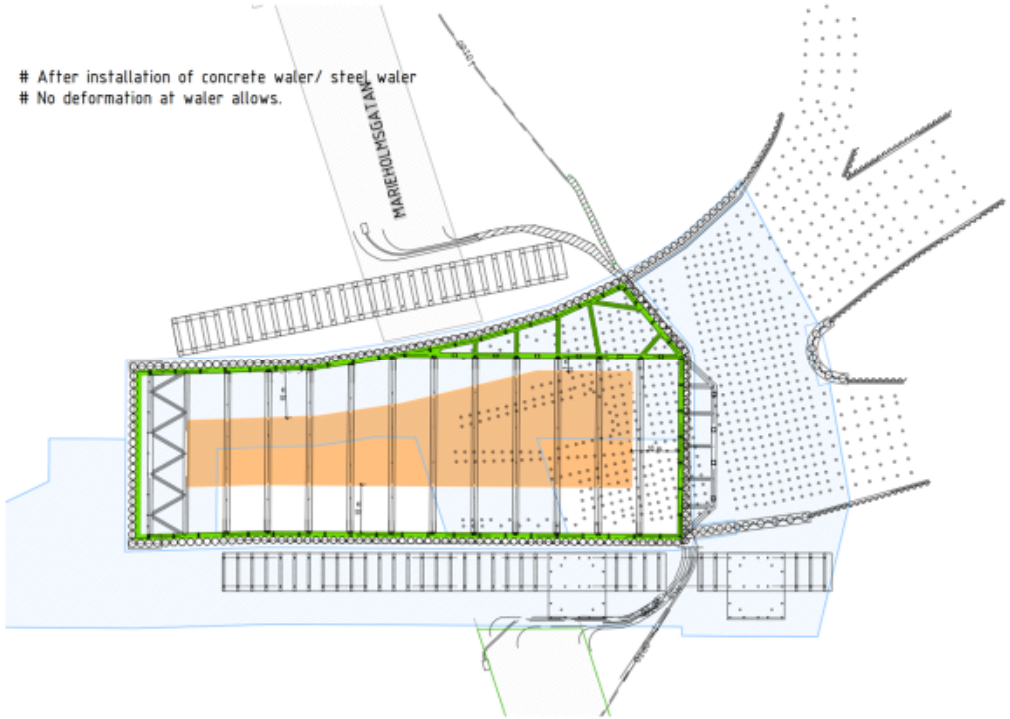




Working sequence

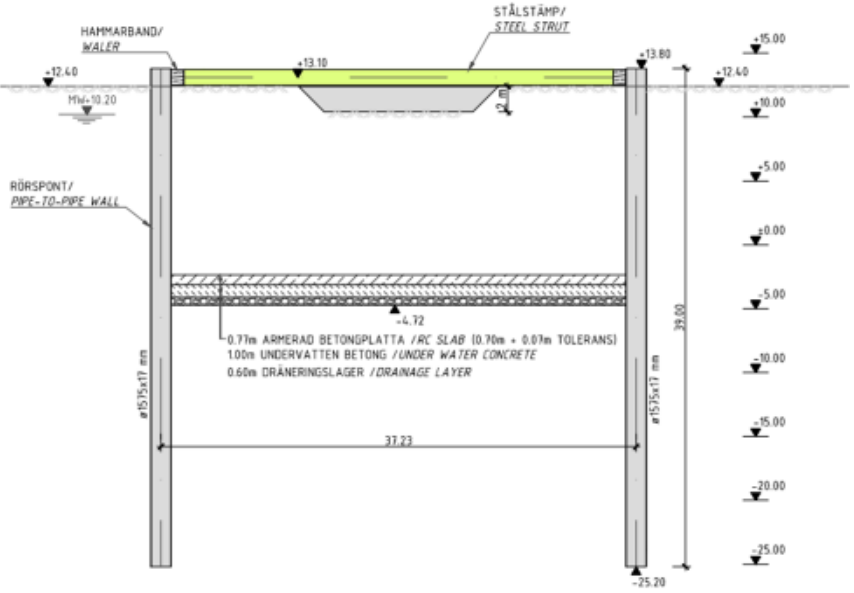
3. Dry prexcavation

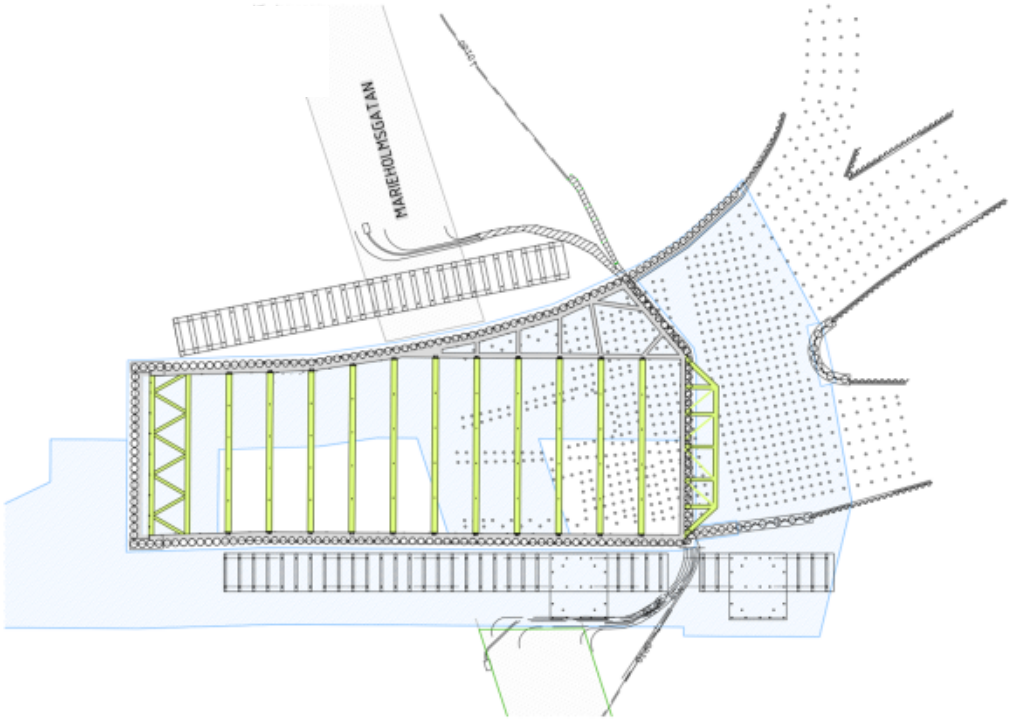




Working sequence

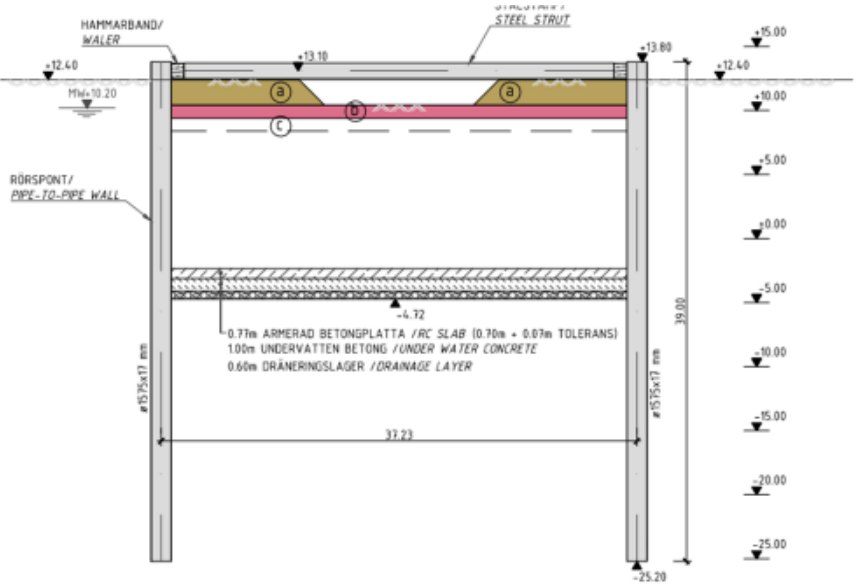
4. Installation of struts

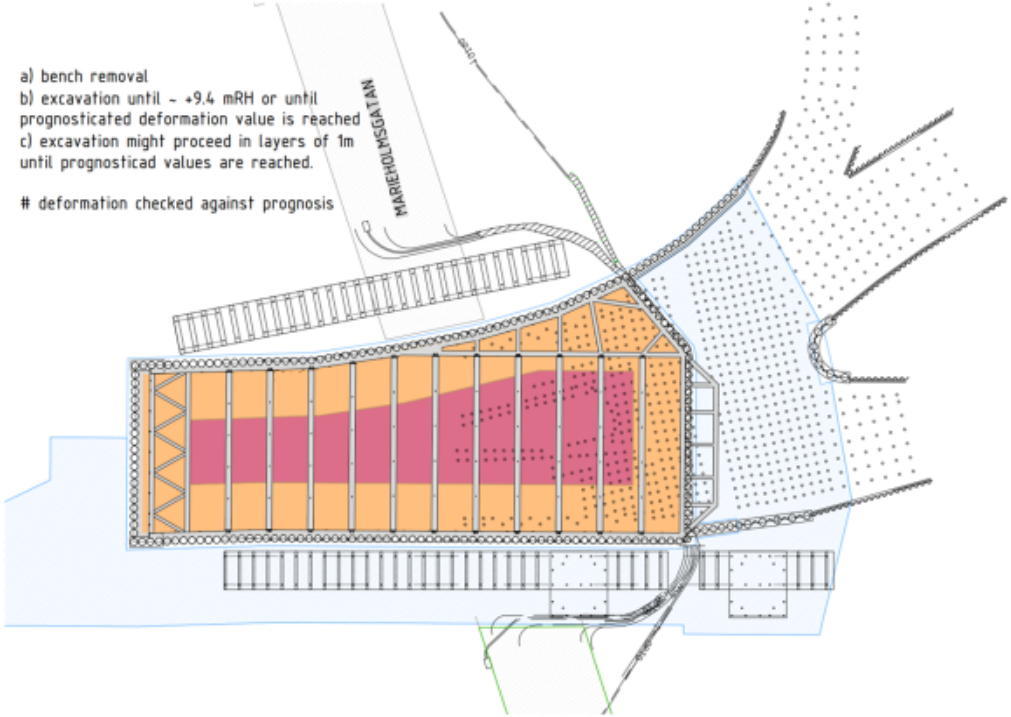




Working sequence

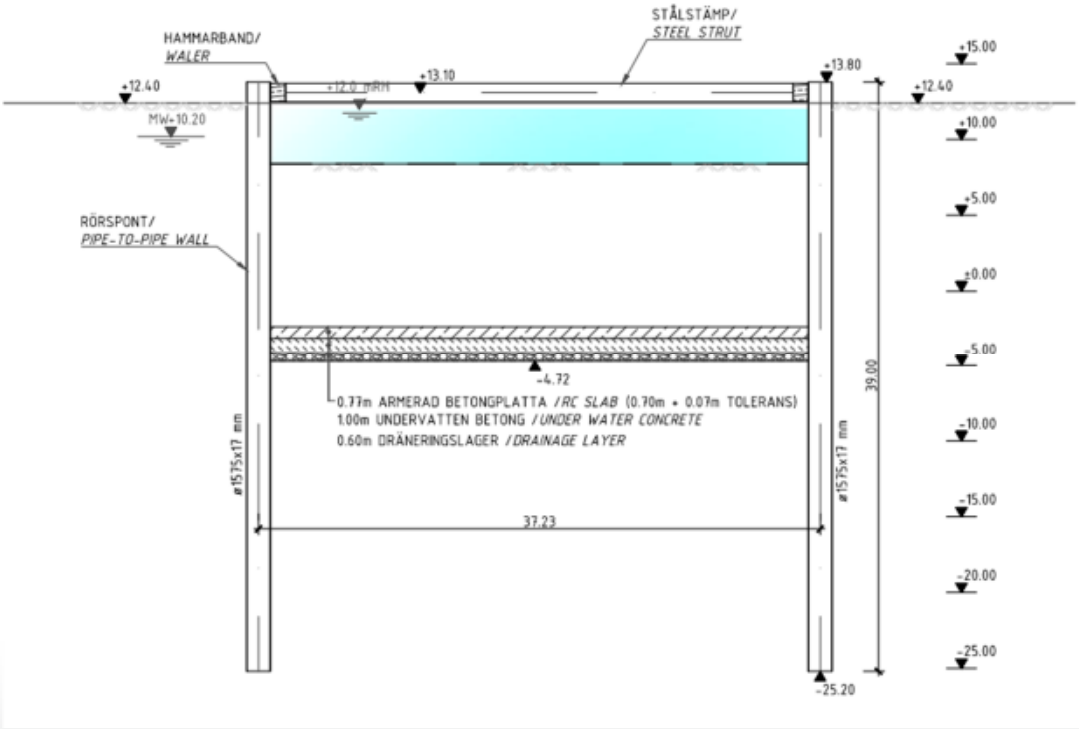
5. Dry excavation





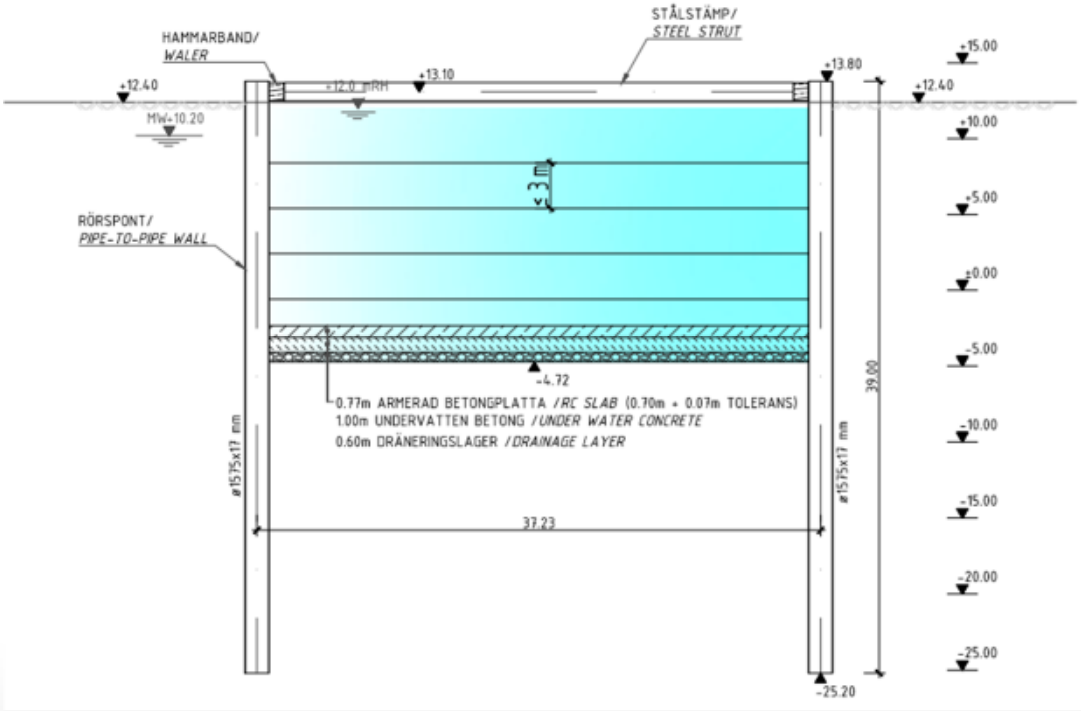
Working sequence

6. Flooding of pit up to +12,0 mRH



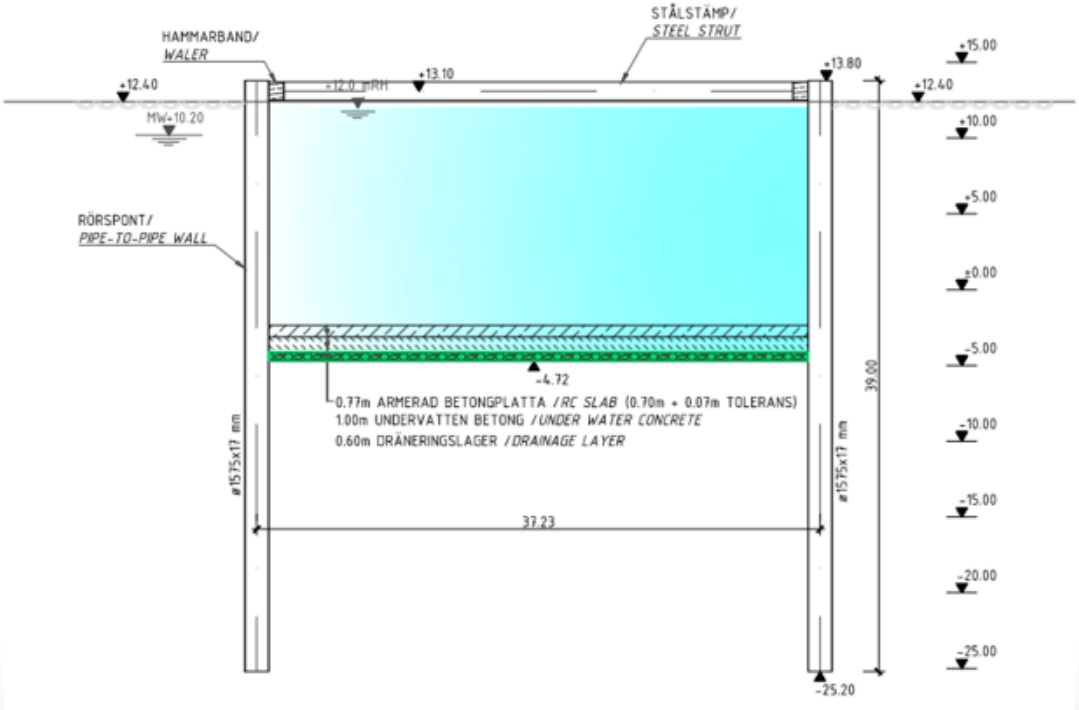
Working sequence

7. Wet excavation in steps of 3m



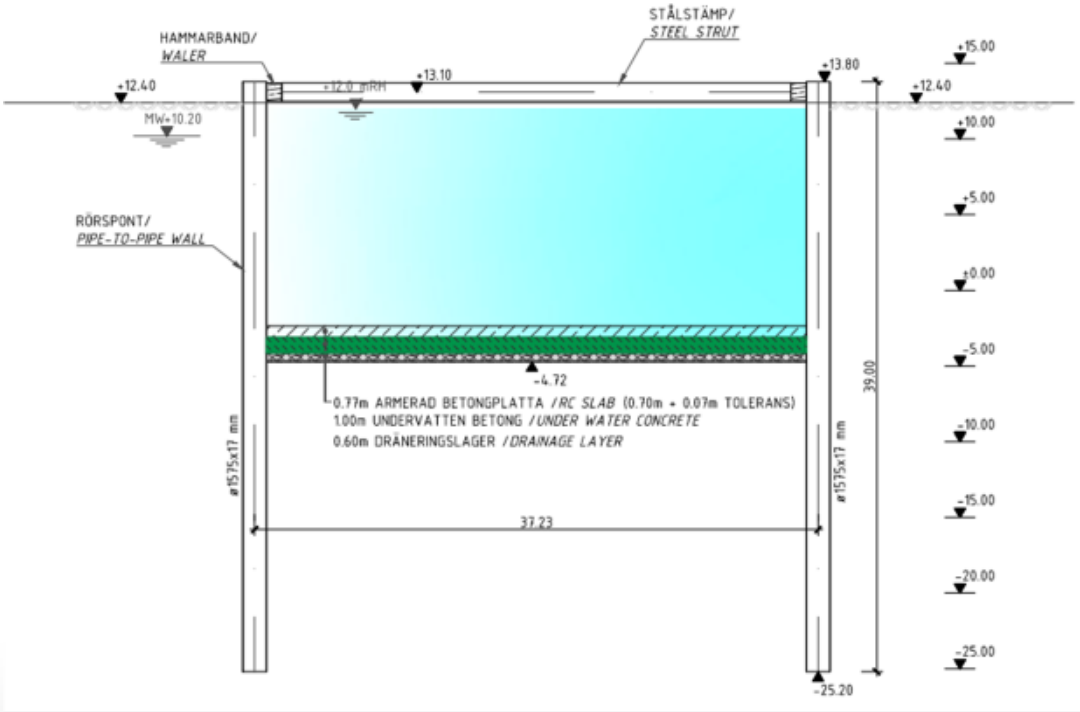
Working sequence

8. Installation of drainage layer with min thickness 0,4 m



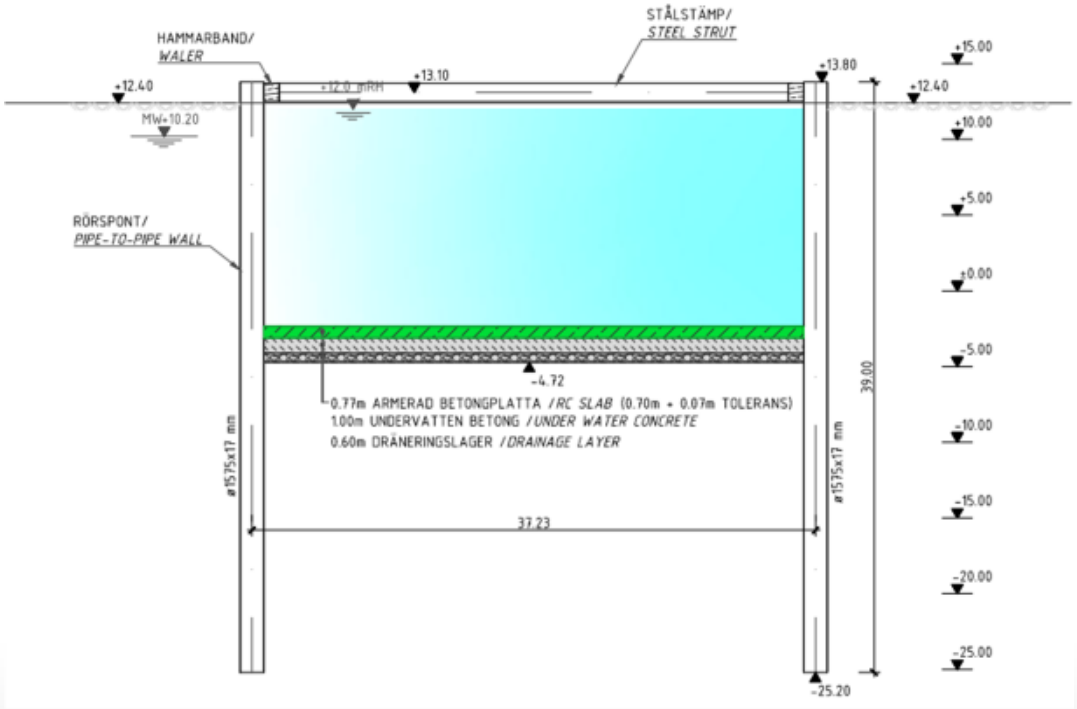
Working sequence

9. Casting of underwater concrete slab with thickness 1,1 m



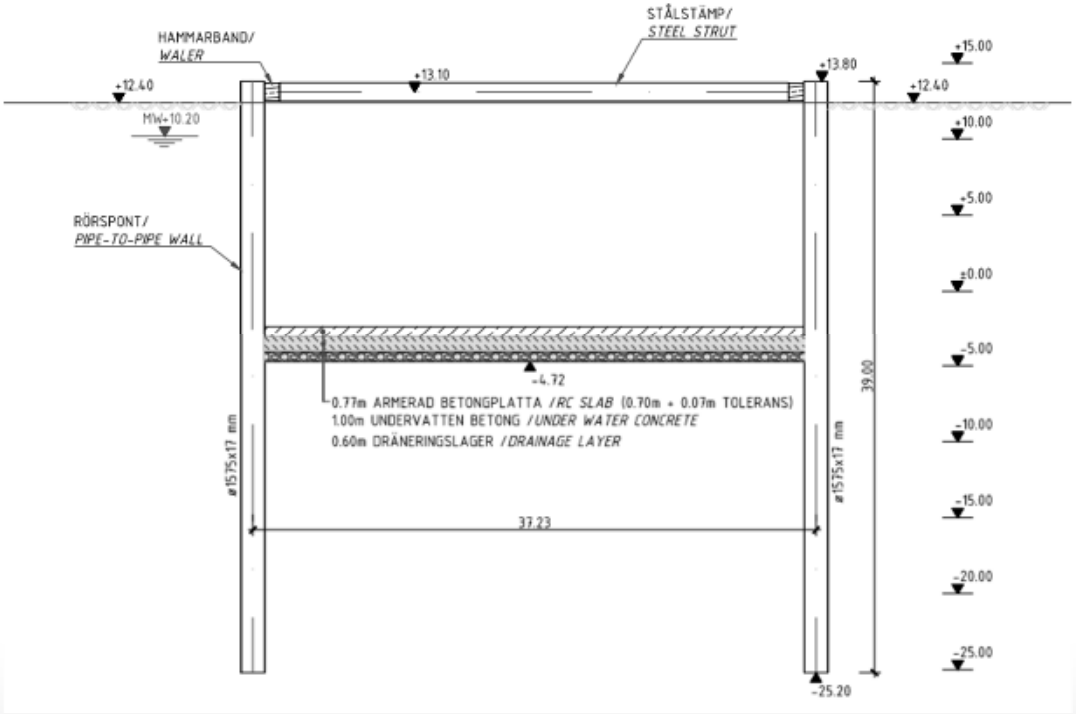
Working sequence

10. Placing of ballast material with thickness 1,0 m



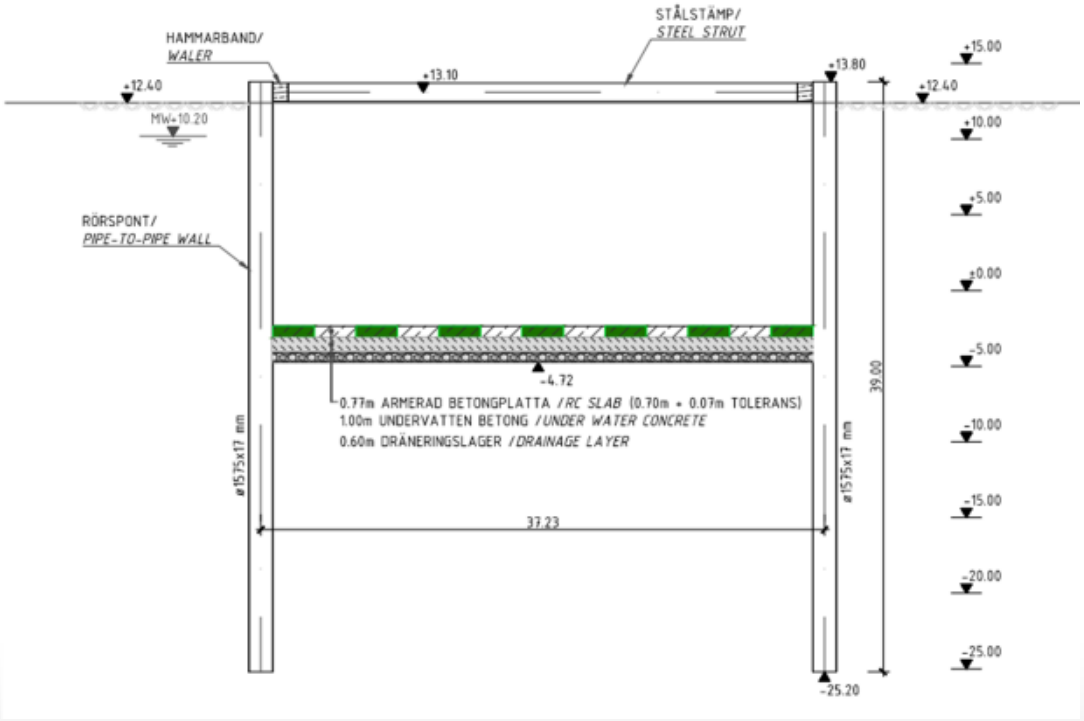
Working sequence

10. Dewatering of pit

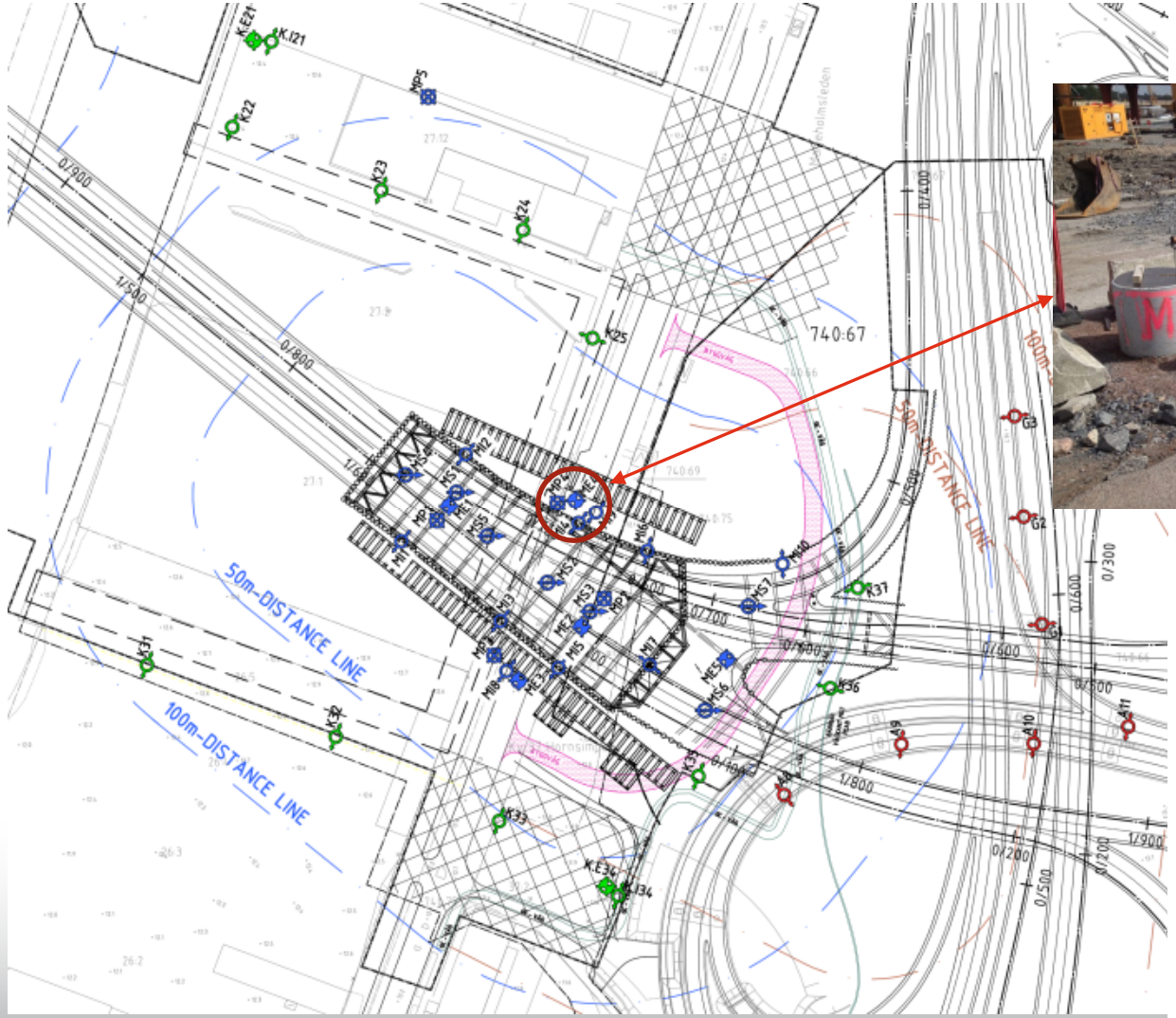


Working sequence

10. Casting of reinforced concrete slab replacing the ballast material in crosswise strips of 5 m

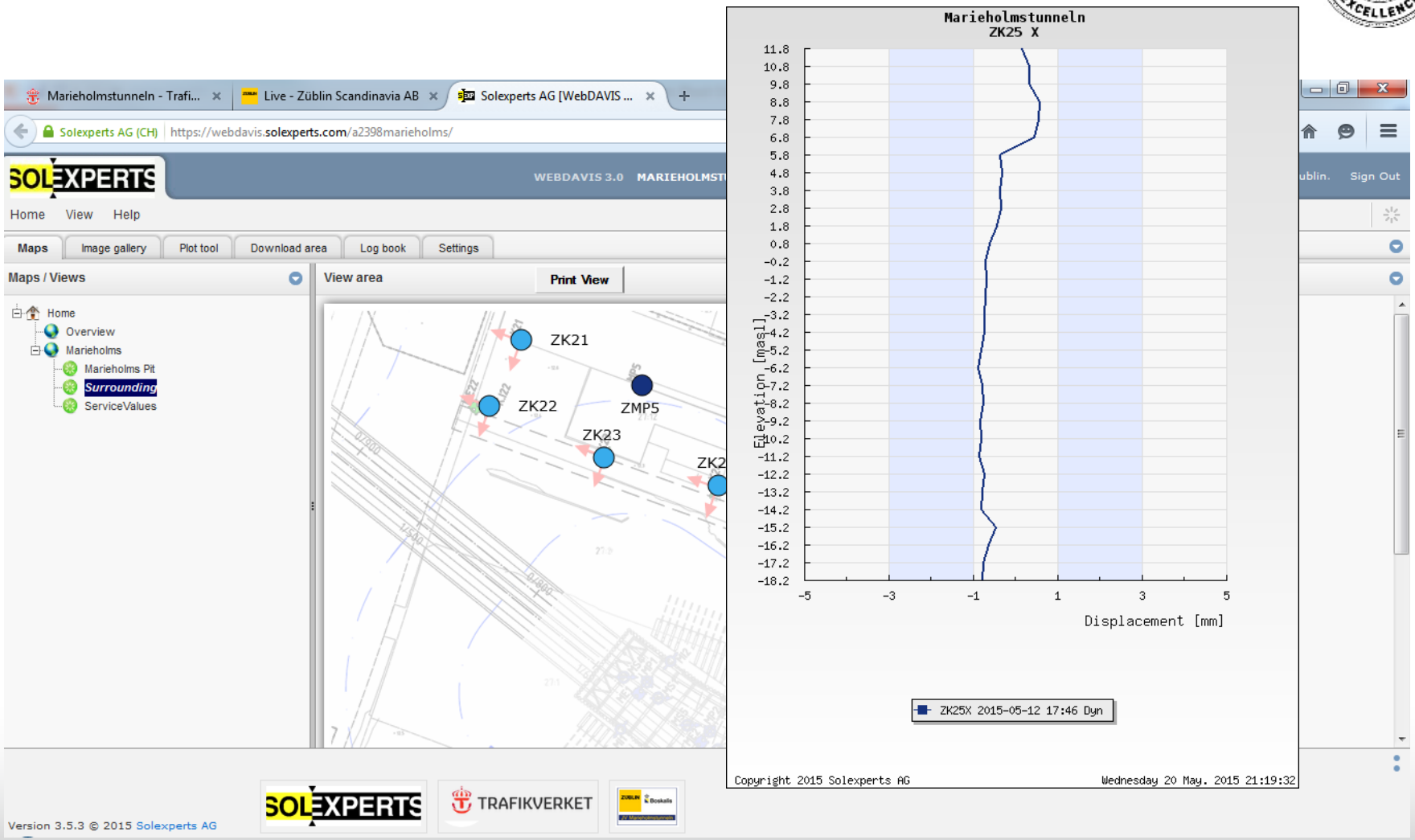


Geomonitoring



- EXTENSOMETER
- EXTENSOMETER (CONSTRUCTION PITS)
- VW PIEZOMETER (CONSTRUCTION PITS)
- STRUT FORCES (STRAIN GAUGES)
- INCLINOMETER: ALREADY INSTALLED, ONLY MEASUREMENT (PARTIHALLSBRIDGE)
- INCLINOMETER: INSTALLATION AND MEASUREMENT (CONSTRUCTION SITE)
- INCLINOMETER: INSTALLATION AND MEASUREMENT (CONSTRUCTION PITS)

Geomonitoring



Working area Drydock

Installation pipe-to-pipe-wall

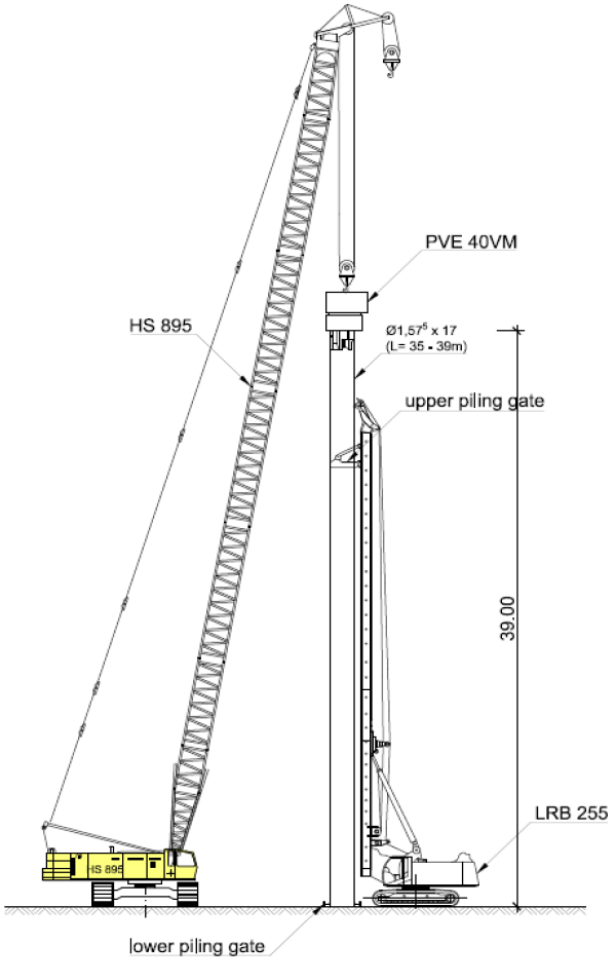
Details pipe-to-pipe-wall

Details pipe-to-pipe-wall

Guiding of pipe during installation

Guiding of pipe during installation

Crane set up for installation



Status of pipe during installation

www.zueblin.se/sv/live