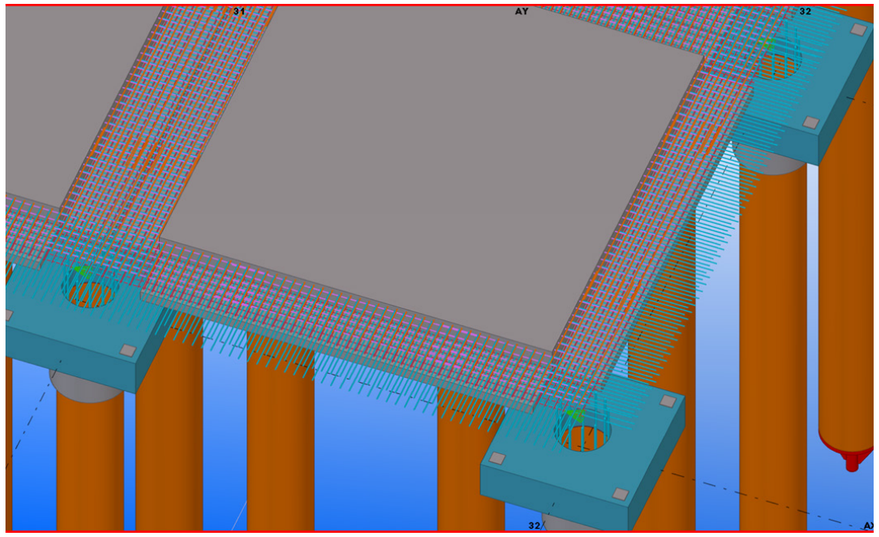
AARSLEFF

Värtahamnen

Extension of Port of Stockholm



Data

- 1,200 rm of quay, water depth to 17 m
- 57,500 m² of pile deck
- 1,000 steel piles, ∅864-∅1168
- 875 precast concrete deck elements, 72-146 tons
- 45,000 m³ of concrete, of this around 500 m³ of underwater concrete
- 14,000 m³ of dredging
- 3,000 m³ of dredging, contaminated material
- 60,000 m³ of excavation
- 80,000 m³ of backfilling
- 14,000 tons of reinforcement
- 1,300 tons of sheet piles, 244 rm
- Sheet pile structure with bored and excavated tie rodss
- 340 rm of retaining wall
- 170 rm of L-shaped precast concrete elements, 20-32 tons
- Jet grouting
- Lime-cement piles
- Scour protection of ferry berths
- Foundations for ramps and passenger walkways.

Client
Exploateringskontoret / Port of Stockholm

Contractor
Aarsleff, Construction and Piling

Type of contract
Design and build (pier and quay) Main contract (infrastructure)

Consultant
COWI A/S

Construction period
February 2013-December 2016

Contract value
Total contract value
DKK 1,220 million
Of this amount:
Pier and quay DKK 1,100 million
Infrastructure DKK 120 million

Contact
Per Aarsleff A/S
Construction and Ground Engineering
Estimation & Tender
kalkulation@aarsleff.com
Tel +45 8744 2222

ANLÆG-196UK-rev.6 11/2021

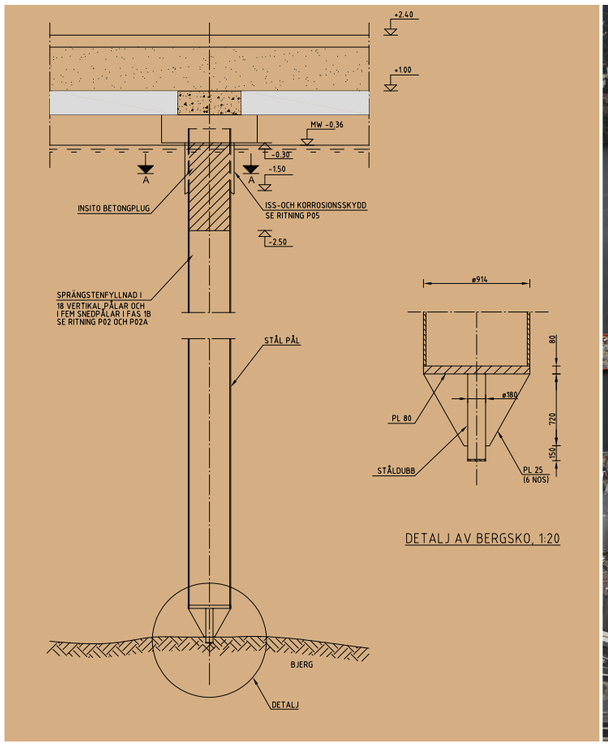
AARSLEFF

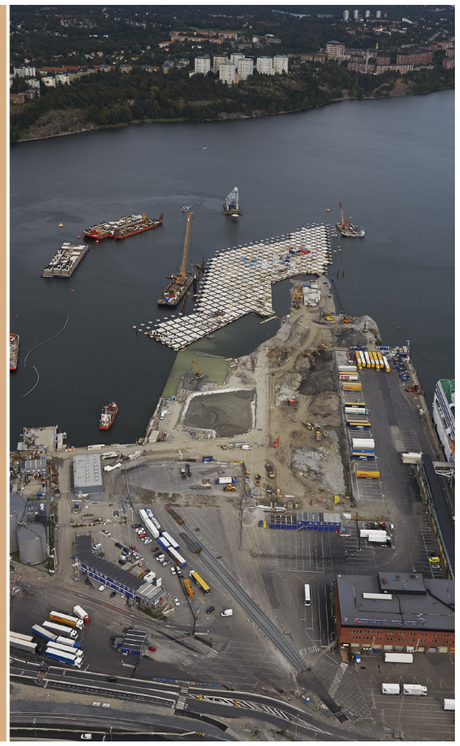
In a design and build contract, Per Aarsleff A/S has extended the largest of Stockholm's harbours, Värtahamnen by 85,000 square metres. The work was carried out from 2013 to 2016. The existing harbour areas were transformed into a new urban area.

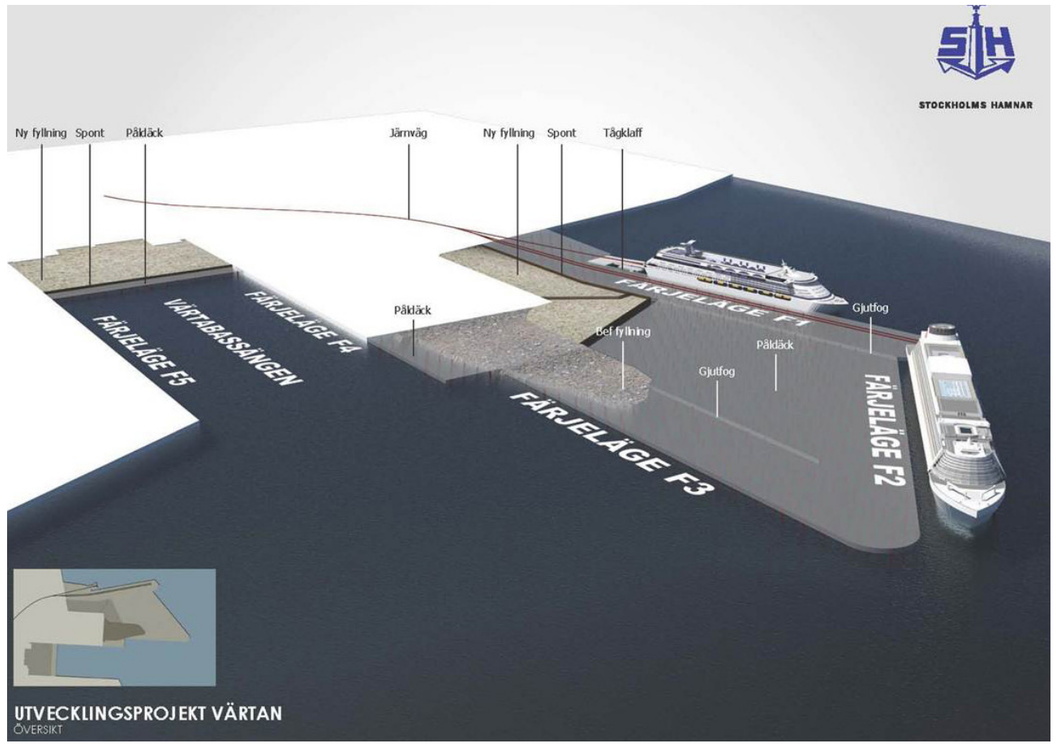
For the harbour project, we extended the pier as a pile-supported bridge deck, and this work involved construction of a new 1,200-metre-long quay with five ferry berths and dredging of the harbour basin.

In addition to the harbour extension contract, we delivered a second contract for which we extended the existing infrastructure at and around the harbour areas.

www.aarsleff.com







Demolition and dredging in contaminated seabed

In the autumn of 2013, we carried out the preliminary work and demolished the existing concrete structures in the old ferry berths. We also reinforced the seabed with lime-cement piles in the harbour basin at the reclaimed harbour area.

In addition, we dredged the harbour basin by means of freeze-dredging, as the seabed was contaminated. Freeze-dredging is a Swedish-developed method where a large steel plate is lowered onto the seabed and then frozen. This way, the upper soil layer on the seabed freezes onto the steel plate and remains there when the steel plate is lifted from the water. Therefore, contaminated soil is prevented from being dispersed into the water.

Part of the dredging was carried out by means of a closed environmental grab bucket – another method that reduces the risk of contaminated soil being dispersed into the harbour areas.

Difficult piling conditions

The extension of Värtahamnen took place under challenging piling conditions. The geotechnics consisted of normal to slightly pre-consolidated clay deposited on sloping, solid rock. The piles for the piled deck were equipped with pile shoes, and the piles were chiselled into the rock. The piles were placed at water depths between 8 and 17 metres and in up to 35 metres of soft clay. The execution tolerances for the piles were very accurate and the weak clay did not give any side support to the 53-metre-long piles, and the piles tended to skid at the tip of the sloping rock. Still, we managed to place the piles within the specified tolerances.

The weak clay had the following properties:

- High-plasticity (w_L: 59-82)
- Normal to slightly pre-consolidated (OCR: 0.9-1.8)
- Very weak to weak (undrained shear strength: c_u=4+0.9d ≈ 4-30 kPa)

Piles, sheet piles and rock fill

At the beginning of 2014, we started the sheet piling work for a 244-metre sheet pile wall and 1,000 steel piles in lengths up to 53 metres and up to 1,168 millimetres in diameter. All steel piles were driven from our own pontoons offshore. Predrilling was required for the steel piles placed on the slope of an existing rock fill area, as this area contained relatively large quarry-stones.

Custom-designed bridge deck

The new bridge deck consists of precast concrete elements installed on 1,000 steel piles. Pile caps were installed on each steel pile to protect the piles against ice in the winter and to support the concrete elements, measuring 8 x 8 metres and weighing up to 146 tons. Subsequently, we cast the concrete elements together.

All precast concrete elements and pile caps were fabricated at Aarsleff's Polish factory in Swinoujscie and then transported on barges to Stockholm.

Finally, we carried out paving work, inclusive of drainage and connection to the sewer system, and we delivered all technical installations required.