ArcelorMittal Sheet Piling

ArcelorMittal

Urban Development in Nordic countries

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- *Skanska Sverige AB | SE*
- *Sweco | DK*
- *Vandkunsten | DK*

Photo front cover: Metropolis, Copenhagen | DK

Contents

Urban Development in Nordic countries

Steel sheet piles are well accepted in the design and execution of permanent port and waterway projects. But they can also be used for terrestrial applications. This document showcases building developments such as residential, business, cultural, etc. Some of the projects are built on the waterfront, combining both water and terrestrial applications.

The use of steel sheet piles as permanent retaining walls is in line with the new trend towards climate change, reducing the environmental footprint and enhancing circular economy. Steel sheet piles can be recovered at 100%, **reused** up to 10 times before being **recycled** at 100%, hence their environmental impact is lower than structures built with alternative materials.

The **EcoSheetPile™ Plus** manufactured in our mills in Luxembourg is produced out of 100% recycled material (steel scrap) in an electric arc furnace (EAF). The EAF utilizes since 2021 **electricity from renewable sources**. Consequently, **our steel solutions contribute even more to a low carbon footprint** of urban projects and infrastructure.

Additionally, solutions with steel sheet pile walls can be executed faster than alternative structures, can be 100 % watertight, and in urban areas, their execution leads to less disturbance to neighbours.

1. Sweden

New Hospital, Kungälv

In Kungälv, a small city 20 km north of Gothenburg, the expansion of Kungälvs Hospital is ongoing. The expansion project is divided into several stages and Skanska has been awarded stage 1 that includes 280 new rooms spread over two buildings as well as a power reserve building and an intermediary building that connects the new buildings with the existing hospital. The hospital will extend its area of admission, but the expansion already takes into account the fact that people will become significantly older and therefore will have greater need for care than ever before.

The ground on which the new hospital is being built has major geotechnical challenges as the strength of the clay is low and the bedrock has a steep slope. The foundation work is therefore a significant part of the project. The two large hospital buildings are erected with basements and in order to be able to excavate for the basement floor, sheet piles are required in certain areas. For the two new hospital care buildings, i.e. building 16 and building 17, different installation methods have been used due to large variations in the depth of the clay between the two areas. In both cases, the sheet piles were installed with Movax units.

In building 16, AU 14 and AU 18 sheet piles were installed at the outer perimeter of the building to a prescribed depth of 10 to 18 m. Wailing beams and connectors were mounted on the main wall and connected with tie rods to a shorter anchor wall (see Figure 2).

In the area of building 17 the depth of the clay is at a higher level and varies more. Part of the sheet piles are therefore driven down to bedrock elevation and the remaining parts are installed to a prescribed depth of 10 to 16 m. Different types of sheet

Fig. 1 – Aerial view of Kungälv Hospital (© Skanska - Sweco).

piles, including AU 14, AU 18, AU 23 and PU 32, have been used with the aim of optimizing the amount of steel in relation to the strength requirements for the different zones. The optimization led to cost savings and lower environmental impact.

The sheet piles used on building 17 are anchored with one or more levels of ground anchors and wailing beams. Due to the low strength of the clay, excavation works, and assembly of the wailing, were carried out alternately in the various work areas and levels according to a carefully planned schedule to minimize downtime.

After the base slab and basement walls were cast, the space between the sheet piles and basement wall was filled. Most of the sheet piles were subsequently extracted and cleaned in order to be reused in future projects.

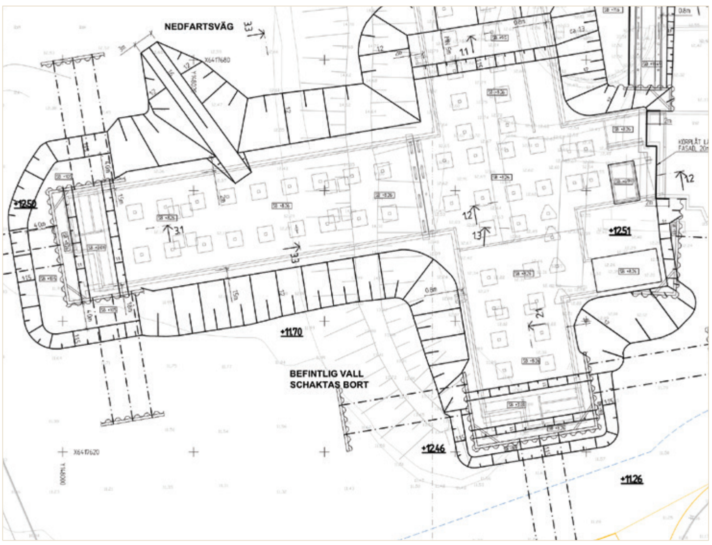

Fig. 2 – Plan view of building 16. AU 18 in L=18 meter on the perimeter of the building. Behind the main sheet pile wall, a short stretch of AU sheet piles in shorter lengths constitutes the anchor wall.

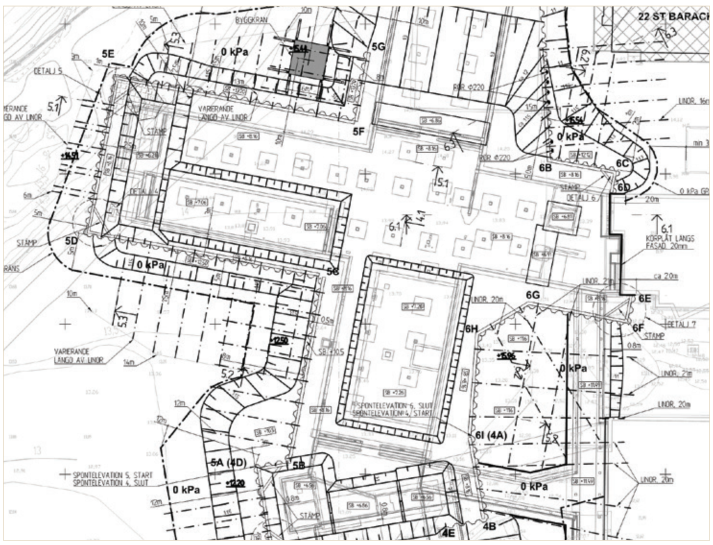

Fig. 3 – Plan view of building 17. AU 14, AU 18 and AU 23 of varying lengths have been installed around most of the building. The sheet piles are fixed with ground anchors (strands) to the mountain.

Fig. 4 – Welding of a wailing on the sheet piles for building 17.

Fig. 7 – Extraction of the sheet piles ongoing for building 16.

Fig. 5 – Fully excavated pit of building 17.
The building is founded on concrete piles.

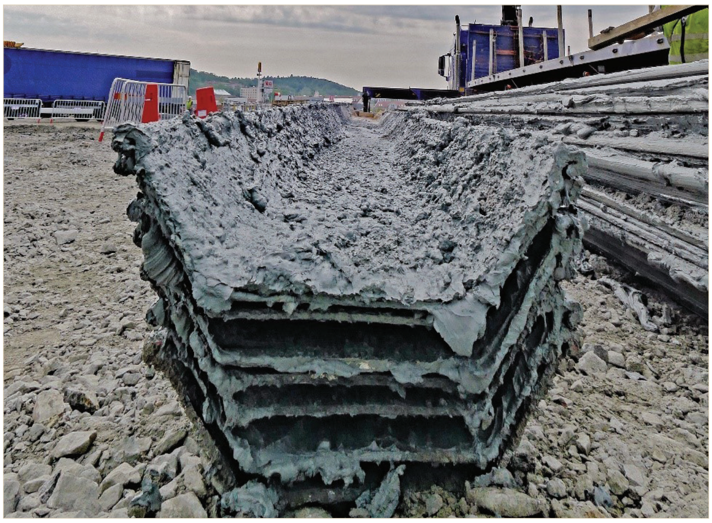

Fig. 8 – Extracted sheet piles that can be reused after cleaning
for future projects.

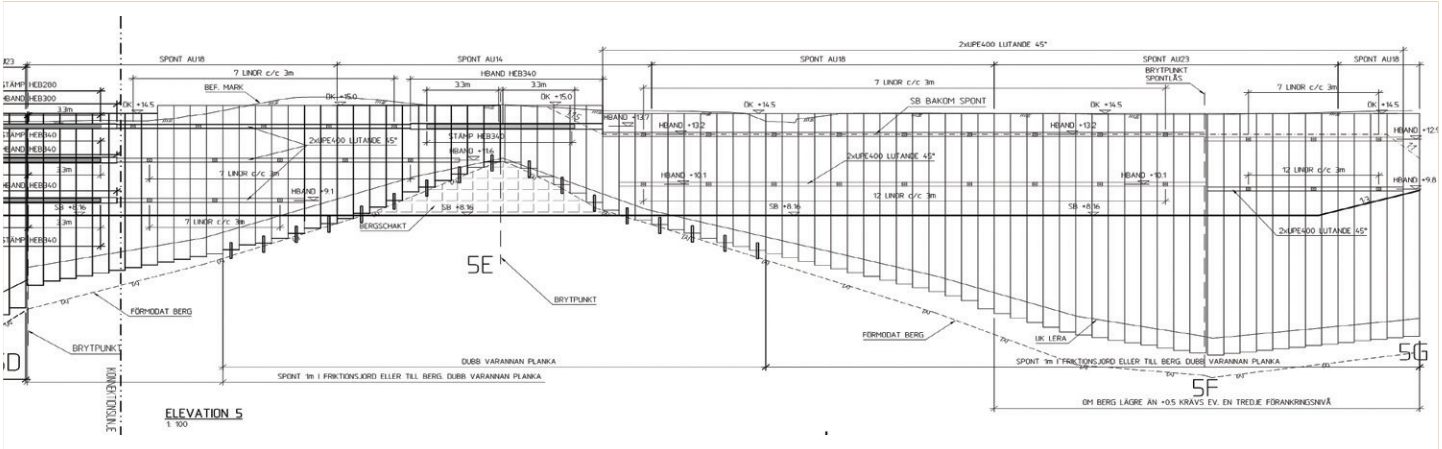

Fig. 6 – Elevation showing part of the sheet piles for building 17 in an area where depth to rock was as low as 3.5 meters (use of rock bolts).

Facts & figures

Client	Västfastigheter | SE
Contractor	Skanska Sverige AB | SE

Steel sheet piles

AU 14, AU 18, AU23	S 355 GP	7.0 to 18.0 m	683 t
PU 28, PU 32	S 355 GP	17.0 & 18.0 m	92 t

Corner sections

Omega 18, C9

2. Norway

2.1. Bjørvika B6A and B6B, Oslo

Bjørvika is one of the largest urban development projects in Oslo and it has been going on for quite a long time. The Opera, the Barcode series, the homes on Sørenga, the Munch Museum and the new Deichman main library are among the projects built in recent years. The latest addition to this development lies in the central part of **Bispevika**, which has been named *Vannkunsten*, after the Danish architectural firm Vandkunsten, the architects in charge of the project. B6A consists in the construction of 215 apartments and some commercial units (shops) spread over a few buildings surrounded by water.

A temporary **watertight cofferdam** was built with **AZ and AU steel sheet piles driven 15 to 16 meters into the ground** to allow the execution in the dry of the deep foundations of the buildings. After the installation of the surrounding temporary sheet pile wall, the work platform was cast at elevation -2.85 m, almost three meters below the seawater level.

The seabed consists of very loose soils such as soft clays, sawdust from the sawmills in Akerselva and old backfills. As predicted in the design stage, parts of the sheet pile wall shifted up to a few meters shortly after the installation, without any damage to the wall nor any negative influence on its stability. Before starting the execution of the deep foundations, the upper portion of the very soft clay layer and an old sheet pile wall inside the perimeter of the new construction field had to be removed.

The new buildings rest on up to 60 meter long piles consisting of small diameter steel casings (from 168 mm to 324 mm) filled with concrete that go deep down to the bedrock. During this works, many old timber piles and wood were found in the fills, the latest fills dating back to the 1970's.

In addition to the piles, considering the poor and unstable ground conditions, two permanent retaining walls that are roughly 40 and 50 meters long were built along the site.

Another challenge was the presence of the submerged tunnel that lies relatively close to the new foundations, reason why the pore pressure in the soil had to be monitored continuously on that side of the jobsite.

B6B will also use steel sheet piles for the execution of a cofferdam. Approximately **600 tonnes of AZ and AU sheet piles** will be delivered as **double piles crimped** fitted with the **sealing system Beltan™ Plus** (winter version), and driving is foreseen in late 2021. It will also be one of the first projects in Norway utilizing **EcoSheetPile™ Plus**, ArcelorMittal's new brand for low carbon steel sheet piles produced from 100% scrap and 100% renewable electricity.

Construction start: B6A - spring 2017 (steel sheet piles)
B6B - November 2021 (steel sheet piles)

Completion: B6A - Easter 2018 (foundations - buildings ready for occupancy by 2020 - 2022)

Contract amount: B6A - buildings NOK 739 million – including foundations at NOK 50 million (all amounts excl. VAT)

Fig. 9 – Björvika.

Fig. 10 – Björvika – construction.

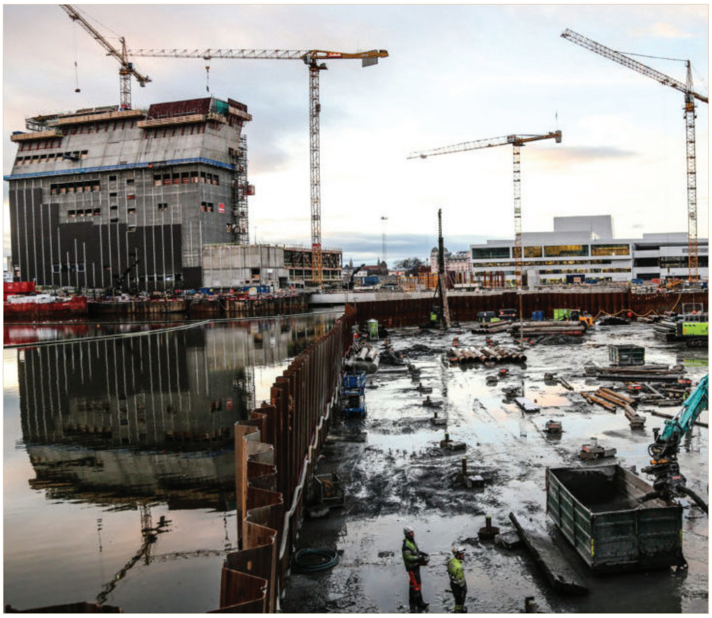

Fig. 11– Björvika – construction.

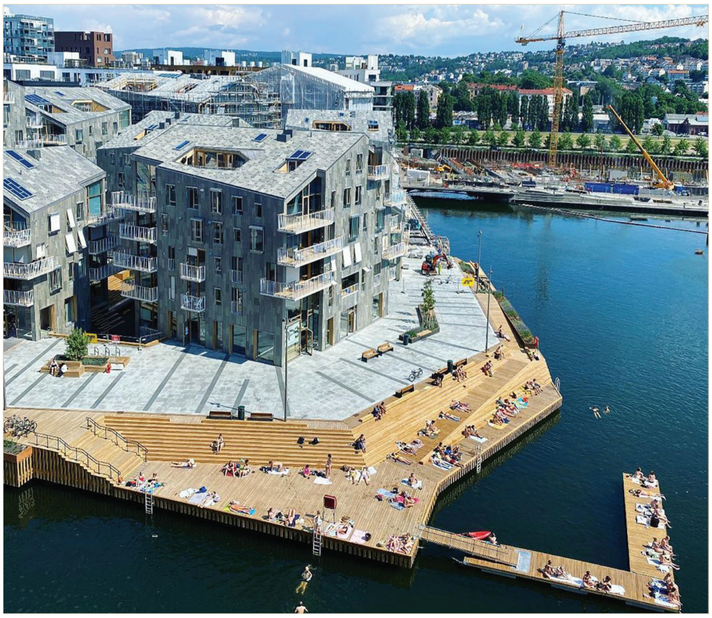

Fig. 13 – Björvika - Aerial view.

Fig. 12 – Björvika – plan view.

Facts & figures

Investor	Oslo Sentrum Utvikling A/S | NO
Architect	Tegnestuen Vandkunsten AS | DK
Piling Contractors	Kynningsrud Fundamentering, Hallingdal Bergboring | NO

Steel sheet piles

AU 25	S 355 GP	14.0 to 20.0 m	1 022 t
AZ 17-700	S 355 GP	15.0 m	298 t
		Total	1 320 t

2.2. Norwegian National Opera and Ballet, Oslo

The Opera House is the largest cultural building built in Norway since *Nidarosdomen*, the famous cathedral located in Trondheim. It is an important symbol of what modern Norway represents as a nation and expresses the role opera and ballet shall have in the Norwegian culture and society.

The building has around 38 500 m² and more than 1 100 rooms, spread over 4 levels and a basement, divided in following sections

- the public area with access from the area adjacent to Oslo Central Station, encompasses the foyer, and 3 auditoriums, where the main auditorium has seating for up to 1 350 people. The Main auditorium is a classic horseshoe shaped opera theatre with a high-level ceiling designed to strict acoustic requirements. The foyer area is a large, open room with varied natural lighting and fine views of the fjord and Hovedøya,
- the stages - the Opera House has one of the most modern and technologically advanced opera stages in the world. The 35 m high stage tower is located above the main stage, allowing for complicated theatre-technical solutions,
- the production section contains workshops, stores, rehearsal rooms, cloakrooms, offices and audition rooms,
- the roof landscape is open to the public. The horizontal and sloping roofs express monumentality and give the building a dramatically different appearance than its neighbours. The cladding of the roof landscape is made with white Italian marble that adds a brilliant artistic effect to the building envelope.

The Opera House functions as a link between the historic downtown Oslo to the west and the Ekeberg hills to the east. It is a cornerstone in the development of a completely new borough. For decades Bjørvika was known for its harbour activities and heavy traffic. The final goal is to convert this part of the City into a vibrant and attractive area for commercial use, dwellings and cultural activities. A premise for this development was the transfer of the E18 motorway into a submerged tunnel passing under Bjørvika.

Foundation works

A large part of the structure lies under the sea level, which posed a major challenge to the execution of the foundations. Besides, a large quantity of polluted soil masses had to be removed and transported to a treatment plant or to a landfill. Pumping to reducegroundwater level and finally the full waterproofing of the building foundations were supplementary difficult tasks.

ArcelorMittal supplied around **1 300 tonnes of AZ steel sheet piles** to build a dry working area, which represents **12 000 m^2 of retaining wall**. The sheet piles were driven into the soil with the interlocks treated with the **Roxan® sealing system** to achieve a very watertight excavation enclosure. The **deepest point of the excavation lied 16 m below the surface of the water**, a major challenge for the foundation contractor: the structure of the main stage was built inside a circular cofferdam with a diameter of 40 m, for which the excavation and casting of up to 2.0 m thick bottom concrete slab was carried out as underwater work with extensive use of construction divers. The excavation started in the dry down to elevation -8.6 m using 3 levels of bracing (concrete ring), then the pit was filled with water and the rest of the excavation down to elevation -16.0 m was performed underwater. The water was finally pumped out after pouring the bottom slab and further work on the basement was carried out without any difficulties.

Part of the building is built over the sea. The slab is at an elevation of 2.6 m above the water level and is founded on approximately **28 km of HP steel piles driven down to bedrock**. The piling foundations have been designed for a **lifetime of 300 years**, hence **the HP piles are encased in a steel tube of 600 mm** diameter, filled with a fibre armoured concrete poured inside the tube up to its head to protect the HP pile from corrosion. The piles were driven down to the bedrock, some of them reaching 60 m under the water surface.

The Norwegian Pollution Control Authority (SFT) imposed very strict rules for the handling of the polluted soil. Approximately 12 000 m^3 of polluted mass were removed, sorted in accordance with degree of pollution and disposed of accordingly. In addition,

Fig. 14 – National Opera and Ballet (© Eric Berg).

an area of approximately 20 000 m^2 of polluted ground was sealed off by a minimum of 50 cm of clean sand filling. A total of 90 000 tonnes of polluted materials was excavated and transported to the approved depot on Langøya near Holmestrand.

The project was carried out in close cooperation with the final user, Den Norske Opera, which is Norway's largest music and stage arts institution. It is the national producer and presenter of opera, ballet, music and dance theatre and concerts.

Extra challenge: archeological remains

Bjørvika is filled with a several metre thick layer of sawdust and chippings from the sawmills that operated along the Aker River as early as the 16th century. This layer helped conserving objects lying on the bottom. Many boats and other artefacts lie under what is now dry land. An important premise for the building permit was thus that the site was to be thoroughly inspected and surveyed for archaeological finds. Archaeologists were present at the building site watching over every single grab load removed. A total of 2 000 large and small objects were found during this phase of the construction works.

Awards

The national Opera received the *European Union Prize for Contemporary Architecture - Mies van der Rohe Award 2009*, a joint initiative of the European Commission and the Fundació Mies van der Rohe.

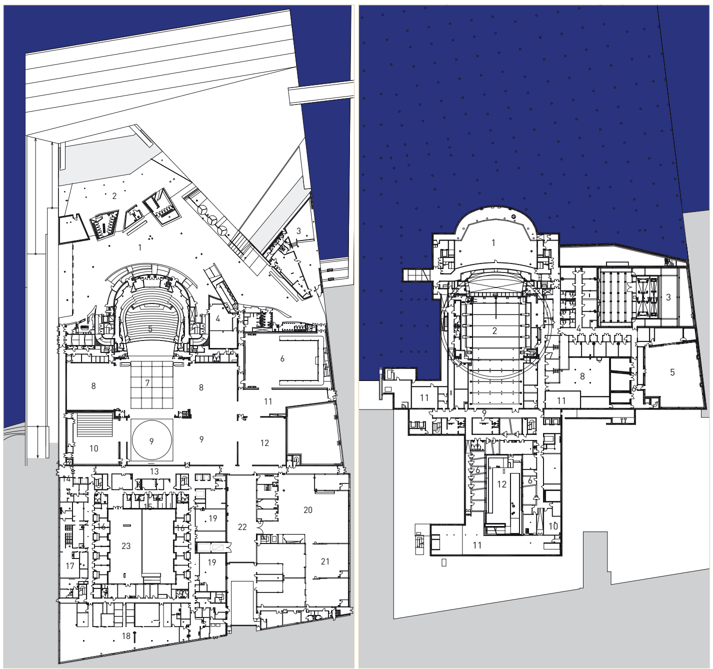

Fig. 15 – General layout.

Summary

Timeline

2003 Foundation works commences on February 17th.

2004 The foundation stone is laid by H. M. the King on September 3rd.

2007 The construction project is completed during the winter.

2008 Moving before the Opening Gala on April 12th.

Characteristics

Gross area	38 500 m²
Building length	207 m
Building width	110 m
Max. ceiling height above stage	54 m
Depth of stage below sea level	16 m

Project cost

Construction project	NOK 4.36 billions

Facts & figures

Project owner	Statsbygg | NO on behalf of the Ministry of Culture and Church Affairs | NO
Architect	Snøhetta AS | NO
Piling Contractors	Entreprenørservice & Kynningsrud Fundamentering | NO

Steel sheet piles

AZ sections			1 300 t
Sealing system Roxan®			
HP Piles	S 460 M	up to 60.0 m	3 000 t

Coating: coal tar epoxy (800 µm)

Fig. 16 – Construction works.

Fig. 17 – Aerial view - Munch Museum, Munch Brygge and the National Opera and Ballet.

2.3. Munch Brygge, Oslo

The *Munch Brygge* (*Pier* in English) residential project is centrally located in Oslo between the Opera House and the new Munch Museum. The project consists of four apartment buildings divided into two blocks by a diagonal street, which creates a visual connection between Bjørvika, Sørenga and Ekebergåsen. The total area of the project is around 24 500 m².

The project encompasses commercial premises and kindergarten on the first floor of all four buildings, and 156 luxury apartments. Each apartment is placed obliquely and thus gets excellent lighting and a stunning view of the fjord. The balconies are semi-private outdoor spaces which extend the dwellings with recesses in the façade. The sun plays a game of light and shade on the façades, and the reddish bricks give a warm character to the buildings, contrasting to the area's rather cool colours.

After the groundwork for the new Munch Museum in Bjørvika was completed in 2016, Veidekke / Kynningsrud Fundamentering was awarded the contract to establish the construction pit for the Munch Brygge. The foundations of the project were executed inside a cofferdam built with **635 t of steel sheet piles AZ 17-700 and AZ 26-700 in steel grade S 355 GP, and 16.0 – 17.0 m long**. The interlocks of the sheet piles were treated with the **sealing system Beltan® Plus** to enhance the watertightness of the retaining wall.

The foundation works consisted in installing 5 680 m^2 of steel sheet piles around the construction pit, excavating the soil for an underground car park, stiffening of the sheet piles using an hydraulic bracing system and casting concrete for the working platform.

The sheet piles were installed from July to November 2017 by Kynningsrud Fundamentering, who was also chosen as subcontractor for executing 235 piles to support the four buildings. Approximately 8 000 meters of steel core piles and roughly 3 500 meters of steel tubes were installed.

Awards

Munch Brygge received the Oslo City Architecture Prize 2020, and the Oslo Architects' Association's Architecture Prize 2019.

Fig. 18 – Construction.

Facts & figures

Project owner		Stor-Oslo Eiendom | NO	
Architect		Lund+Slaatto Arkitekter AS, Oslo | NO	
Piling Contractor		Kynningsrud Fundamentering | NO	
Steel sheet piles			
AZ 17-700	S 355 GP	16.0 to 17.0 m	489 t
AZ 26-700	S 355 GP	17.0 m	147 t
		Total	635 t

Sealing system Roxan®

3. Denmark

3.1. Dokk 1, Aarhus

Per Aarsleff achieved a contract to construct the building group *Dokk 1* for the city of Aarhus in 2011. In addition they also constructed a new waterfront. The works comprised the installation of steel sheet pile retaining walls and concrete bearing piles, the demolition of existing quay walls, the lowering of the ground water and excavation.

The building group is approx. 100 x 100 m and 8 m deep with an automatic underground parking system delivered by the company *Lödige* (Germany) with a capacity of 1 000 cars.

In total Aarsleff installed **3 700 tonnes of PU 32 with the sealing system Roxan® Plus** and **PU 12**, as well as 42 000 running meters of concrete piles, and handled 250 000 m^3 of sand and soil.

For the installation of the sheet piles Per Aarsleff used a Hitachi 180 with a vibratory hammer ICE 1412 and an hydraulic impact hammer IHC S90 for the final driving. The sheet piles were driven into the Aarhus clay. The job safety was important since the site was located close to the port and to the railway.

The 28 000 m^2 building area hosts the library and the public service office of the City of Aarhus.

Construction period: summer 2011 to 2017.

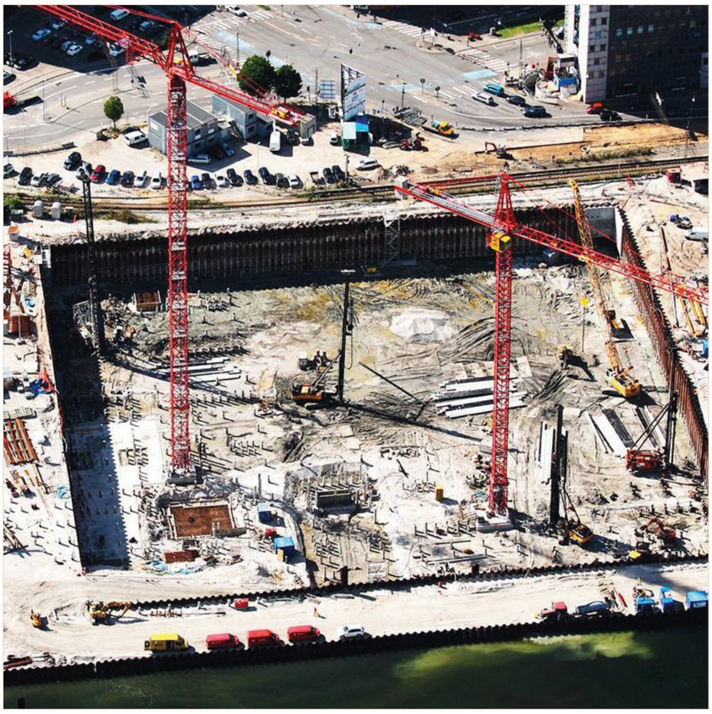

Fig. 19 – Aerial view of the construction pit (© Per Aarsleff).

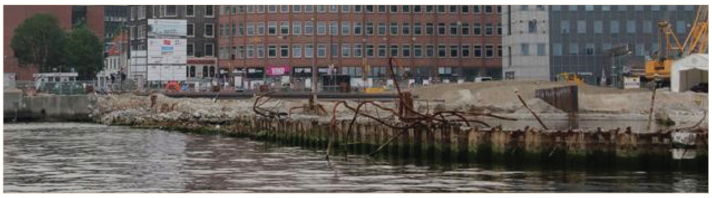

Fig. 21 – Waterfront wall.

Fig. 22 – Aerial view.

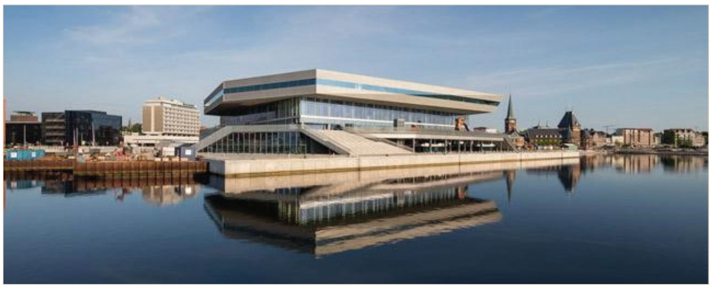

Fig. 20 – View from the water.

Facts & figures

Project owner	City of Aarhus | DK
Architect	Schmidt Hammer Lassen | DK
Engineer	Sweco (Grontmij during the construction phase) | DK
General Contractor	NCC A/S | DK
Contractor foundation	Per Aarsleff A/S | DK

Steel sheet piles

PU 12	S 430 GP	4.6 to 9.8 m	3 700 t
PU 32	S 430 GP	10.8 to 27.3 m	

3.2. Carlsberg building site 6 East, Copenhagen

The site is in the centre of CarlsbergByen, Valby Copenhagen.

The gross area of the project is approximately 66 300 m^2, subdivided in 49 100 m^2 above ground and 17 200 m^2 under ground. It comprises a 3 storey underground car park under the footprint of the building.

The construction pit was built inside of a retaining wall executed with steel sheet piles installed in a slurry wall. The slurry trench was executed with a mechanically operated rope grab (weight of 11.7 tonnes). The sheet piles were then placed in the trench with a crane mounted vibratory hammer.

The excavation depth in front of the walls varies from approximately 8.5 to 13.5 meters.

The walls are primarily anchored with temporary grouted anchors. Along the west and south perimeter 2 parallel walls are mutually connected with tie-rods.

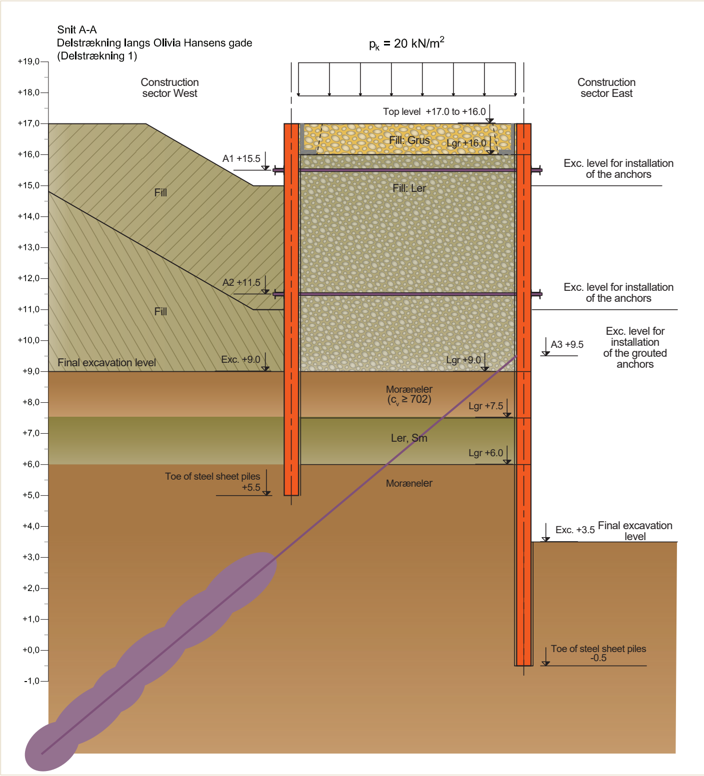

Fig. 23 – Cross section A-A of the retaining wall: several levels of anchors.

The approximate quantities englobe 730 running meters of diaphragm wall, 1 230 tonnes of steel sheet piles, 340 grouted anchors and 90 tie-rods.

The elevation of the ground (fill layers) varies from 0.5 - 1.5 meters in the east end, to 5 - 8 meters in the north-west end. The terrain slopes from east towards northwest corresponding to the increment of the fill layers thickness.

The natural soil beneath the fill is relatively uniform at the entire site with very hard clay till deposits (C_V of 450-550 kPa) down to limestone deposits. There are a few minor and inconsistent occurrences of meltwater sand and clay.

Construction period: 2017 to 2020.

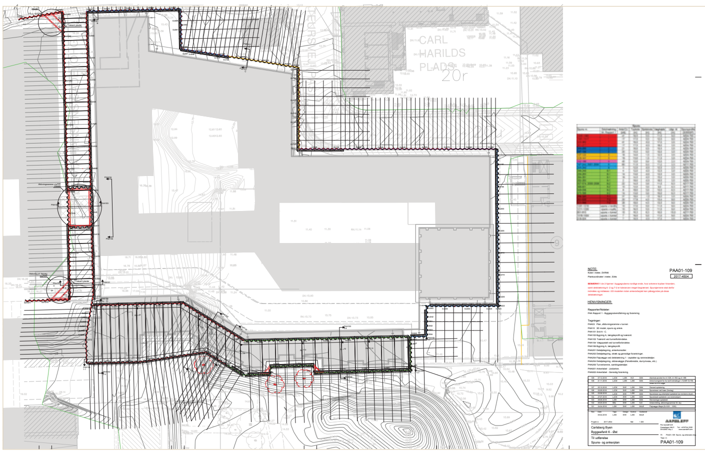

Fig. 25 – Plan view of the retaining walls.

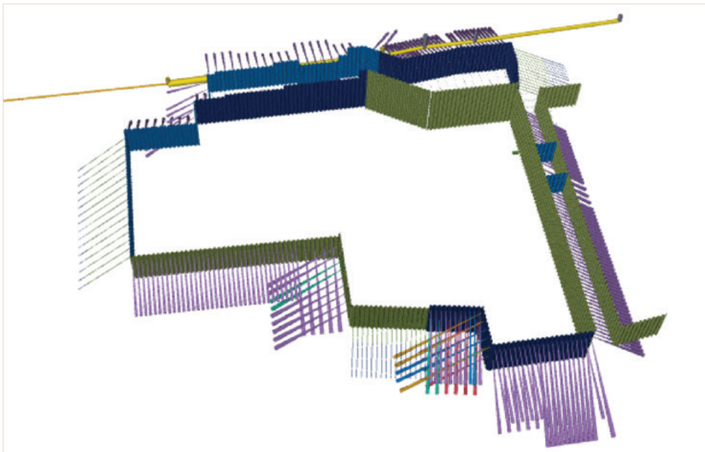

Fig. 26 – A 3D model of the sheet pile retaining wall.

Fig. 24 – View of the future building (© Cadwalk).

Fig. 27 – Retaining wall with 2 anchor levels.

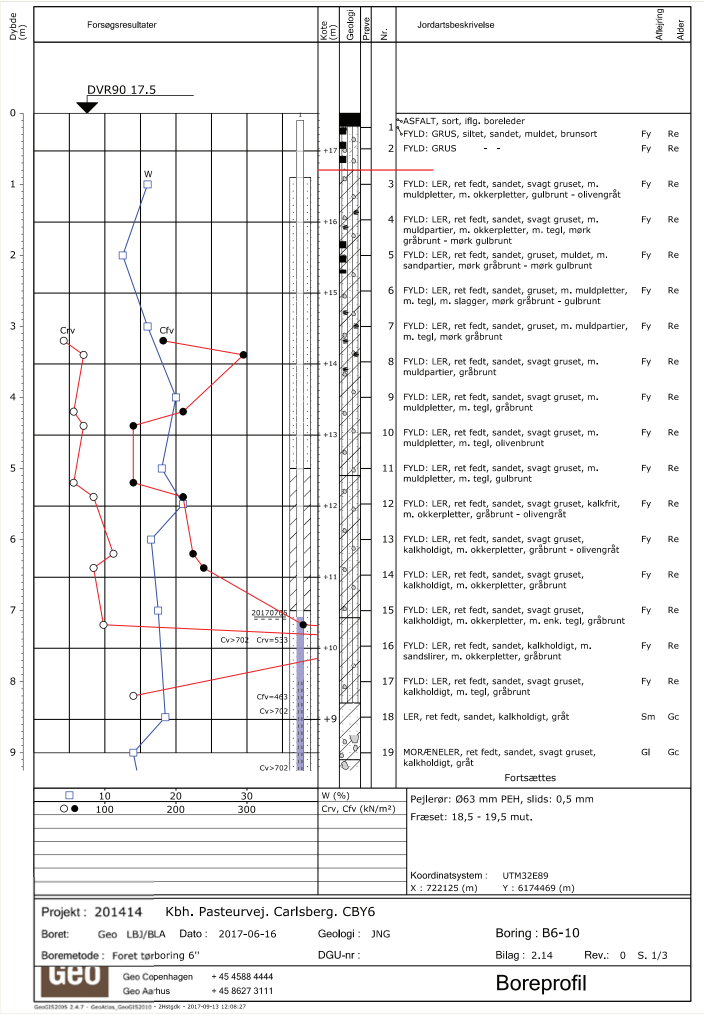

Fig. 28 – Borehole B6-10 (West).

Fig. 29 – Detail of one of the retaining walls.

Facts & figures

Project owner	Carlsberg Byen P/S | DK
Architect	Wingårdhs | DK
Engineer buildings	ÅF Consult | DK
Engineer construction pit	Per Aarsleff A/S (Design & Engineering) | DK
Main Contractor	Per Aarsleff A/S | DK

Steel sheet piles

AZ 17-700			
AZ 20-700	S 355 GP	9.0 to 19.5 m	1 230 t
AZ 24-700			

3.3. Metropolis, Copenhagen

Metropolis is one of the most spectacular estates with a unique location on an artificial island. The estate consists of 82 flats of 108 to 237 m^2, totalling 14 000 m^2, and next to it is the port basin. Owners of these flats have remarkable views across the port, the channels and *Amager Fælled*. The access to the underground car park, as well as to the marina is just outside the door.

The reclaimed land is enclosed by steel sheet pile retaining walls installed by the company Per Aarsleff. It also built the concrete piles, anchorage, as well as the pedestrian bridge on the outer side of the sheet piles.

The installation was performed with a Hitachi 125 GLS with a 5 tonnes hydraulic hammer.

The AU-type sheet piles were chosen due to their width (750 mm, requiring the installation of less anchors) and cost-efficiency, as well as the long service life.

Construction period: April 2006 to March 2008.

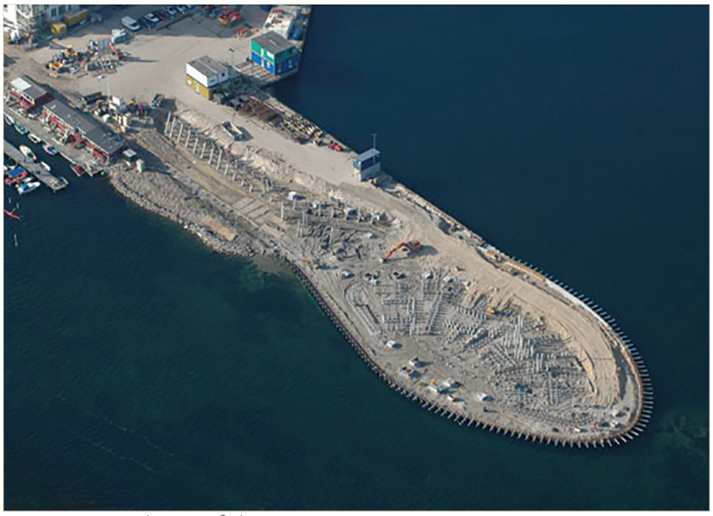

Fig. 30 – Aerial view of the construction site.

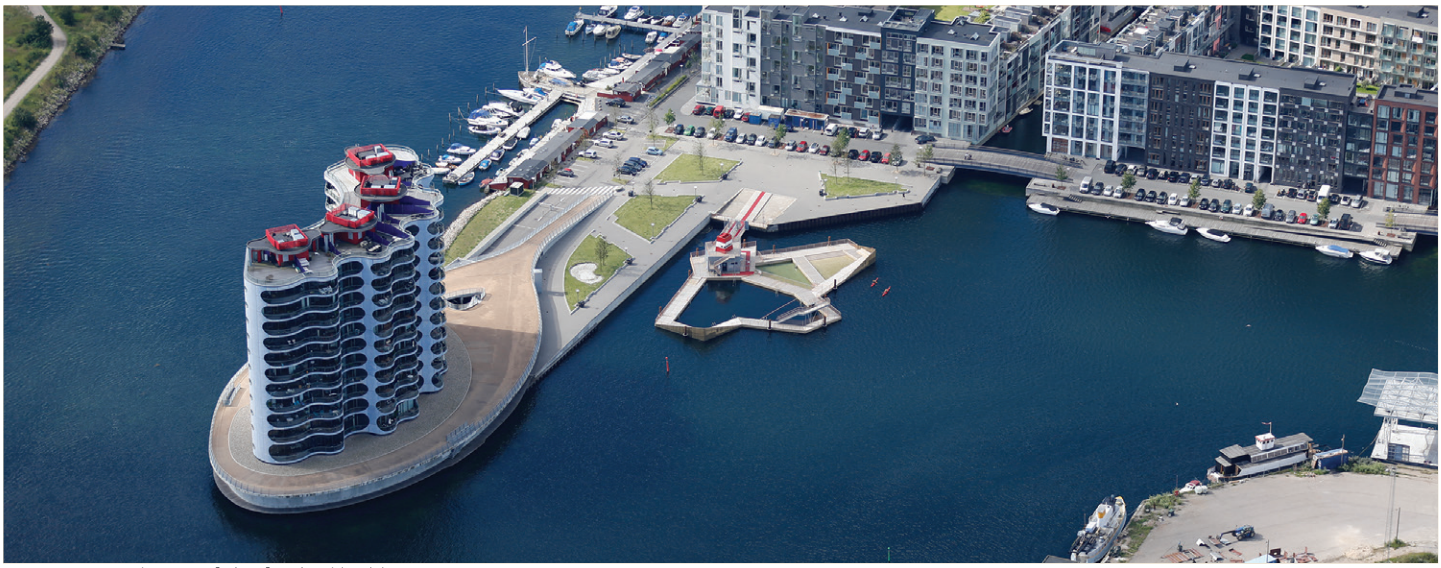

Fig. 31 – Aerial view of the finished building.

Facts & figures

Builder	Metropolis A/S | DK
Contractor foundation	Per Aarsleff A/S | DK
Contractor	KPC A/S | DK
Design Engineer	Niras | DK
Architects	Future Systems / Kasper Danielsen | DK

Steel sheet piles

AU 20	S 355 GP	7.4 m
AU 23	S 355 GP	11.2 m
	Total	253 t

3.4. Engholmene Construction fields A, B, C, E, F and G, Copenhagen

In connection with the development of a new urban area close to Copenhagen City, the general contractor CG Jensen built several artificial islands with steel sheet piles in the Port of Copenhagen.

Engholmene is the last area on the *Seelandside* that had not yet been renovated. This project completes the city development that the port of Copenhagen has experienced over the last 15 years. The works finished in 2020 and comprise in different sites about 2 600 apartments and around 155 000 m^2 distributed on 10 artificial islands, including around 1 600 new work office spaces consisting of the following projects:

a) Kærholm building field C

b) Myrholm building field E

c) Sivholm building field G

d) Tangholm building field B

e) Lyngholm building field F

CG Jensen is carrying out the land development as a general contractor: installation of steel sheet piles, anchors, etc to reclaim the land from the port, enabling the construction of the buildings. Their work also includes excavation for the water channels and the buildings, backfilling, sourcing, sewage works, design and fabrication of bridges, gardening and lighting in the area.

The excavation is executed in an area with polluted soil of class 0 to 4 that will either have to be cleaned before being used as backfill, or have to be sent to an approved depot.

The sheet piles were driven with an ABI vibratory hammer and a Junttan PM20 carrier with an 6 tonnes hydraulic hammer.

The choice of an **AZ 14-770-10/10** was based on the requirement of *By & Havn* (formerly Port of Copenhagen) of a minimum thickness of 10 mm.

Around one third of the sheet piles were supplied with the **Roxan® Plus sealing system**, mainly for the walls along the sea. The soil conditions consist of fills and boulder clay.

CG Jensen has also constructed the *Myrholm* building.

Construction period: 2015 - 2020.

Fig. 32– Lyngholm, Myrholm & Kærholm – cofferdams and foundations.

Facts & figures

Project owner	NPV A/S (Danish urban and property developer) | DK	
Architects	Kærholm:	Arkitema Architects (now part of COWI) & Grønning Arkitekter (2017 - 22 200 m^2 / 194 apartments)
	Myrholm:	Danielsen Akitekterne (2018-2019 - 2 000 m^2 / 214 apartments)
	Sivholm:	Danielsen Arkitekterne (2019 - 7 000 m^2 / 43 apartments)
	Tangholm:	Arkitema (2019 - 2 000 m^2 / 202 apartments)
	Lyngholm:	Danielsen Arkitekterne (2019 - 190 apartments)
Engineers - foundations	Sweco | DK	
Contractor - foundations	CG Jensen | DK	

Steel sheet piles

AZ 14-770-10/10	S 355 GP	7.0 to 12.0 m	4 420 t

4. Finland

Fig. 33 – Redi – future tallest building in Finland.

4.1. Kalasatama Urban Development, Helsinki

Kalasatama (in English: fishing port) is one of the largest urban development projects in Helsinki. It is in the process of expanding to link up with the central city area. Seaside locations that used to be industrial and harbour areas will gradually transform into a city district where homes, services, jobs and culture are all close by. Kalasatama's diverse housing and population structure will make it an interesting neighbourhood. Tower blocks, townhouses, terraced buildings and floating apartments are among the new building types planned.

The area will consist of owner-occupied, rental, Hitas (price-controlled) and right-of-occupancy apartments. Apartments will also be constructed for students, senior citizens and people with special needs. The Kalasatama area will also be home to thousands of workplaces.

Kalasatama is being developed as a model district of smart city: the aim is to develop services and solutions for improving liveability, to seek new operating models and to offer a growth platform for new enterprises. Innovative solutions to enable efficient energy use and the exploitation of renewable energy sources will also be developed under this project.

Key figures

- 175 hectares
- construction period 2009 – 2035
- 20 000 residents
- 5 000 – 7 000 apartments
- 8 000 jobs
- travel time to the city centre by metro 6 min
- length of waterside promenade 6 km

Sweco has participated in the design process of REDI, an urban and ecological residential district in the heart of Kalasatama, around the metro station. It will be constructed in phases during the next decade. Thanks to the excellent public transport and traffic connections, REDI is close to everything and an excellent example of construction that follows the principles of sustainable development.

Fig. 34 – Plan view of the different sectors.

Fig. 35– Execution of the cofferdam.

4.2. Additional references

References	Steel sheet piles	Steel grade	Length	Quantity
GRK Oy	GU 12N & GU 27N	S 355 GP	8.0 to 12.0 m	830 t
West Pro Oy	GU 12N, GU 14N & GU 21N	S 355 GP	8.0 to 27.0 m	1 485 t
YIT	GU 16N, GU 21N & GU 27N	S 355 GP	6.0 to 24.0 m	2 035 t

Disclaimer

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