Technical solution used for the new Galati Multimodal Platform in Romania

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July 11, 2019 | Constanta

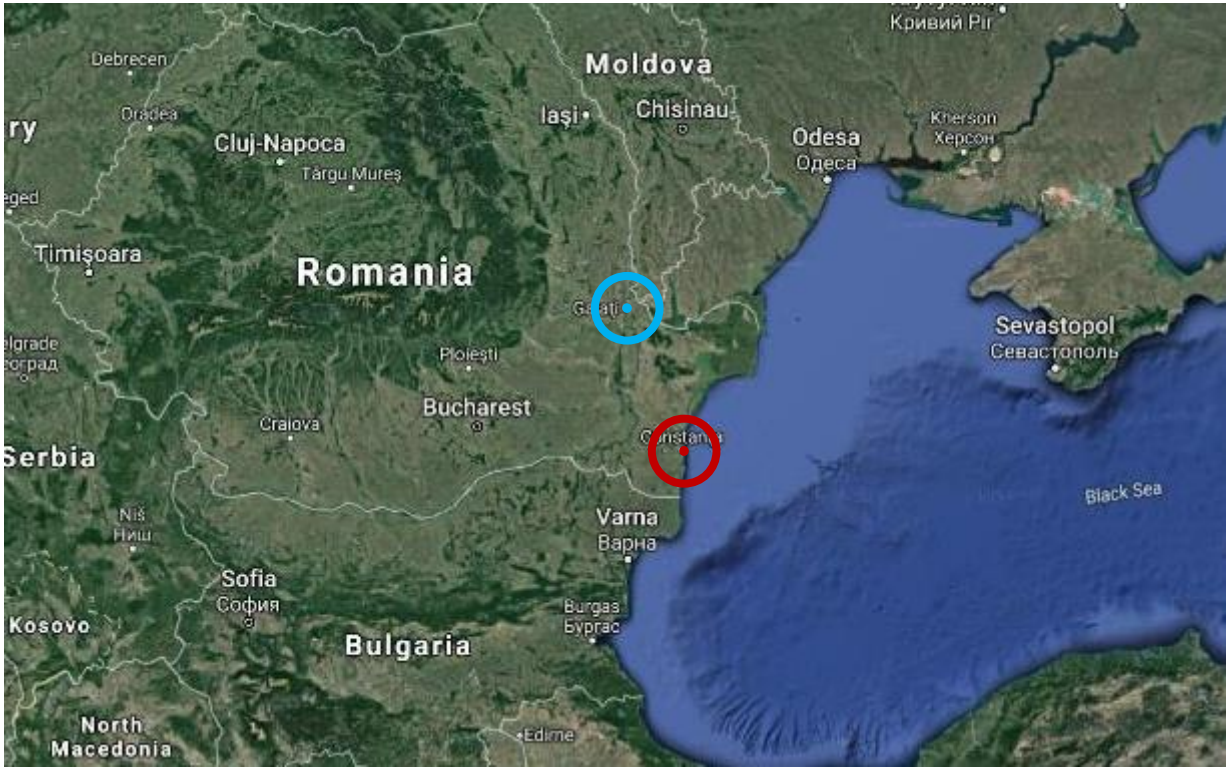
ArcelorMittal Commercial RPS – Sheet Piling - Luxembourg

Dover Western Docks Revival | UK (2018)

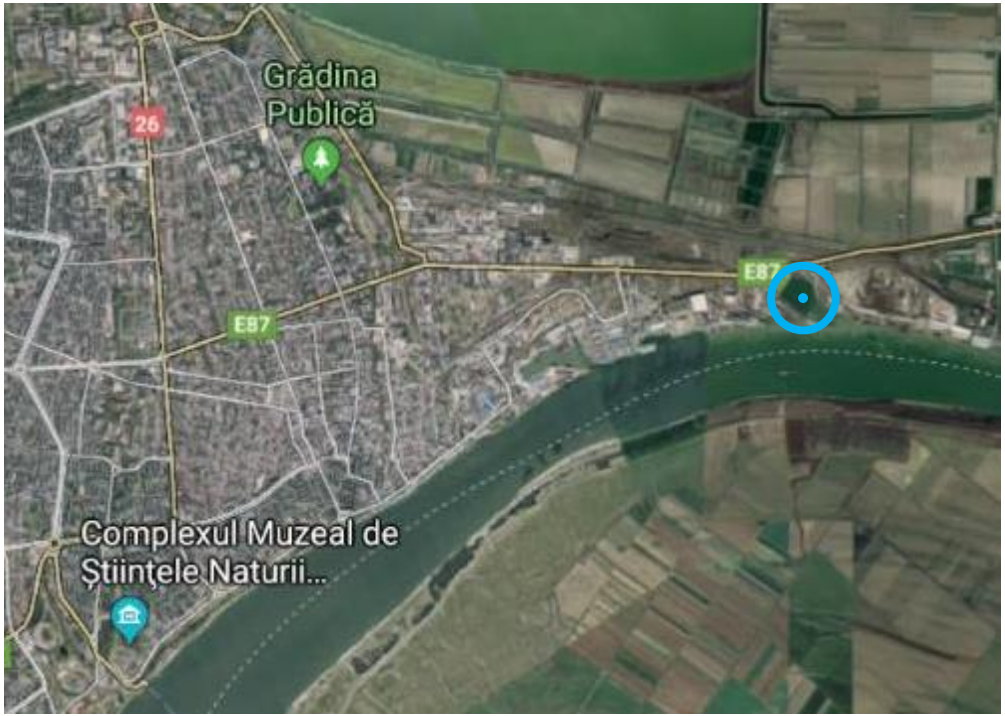
Location

Galați Multimodal Platform

Removing major bottlenecks by substantially upgrading existing infrastructure and bridging missing links for the **Rhine Danube / Alpine Core Network Corridor**



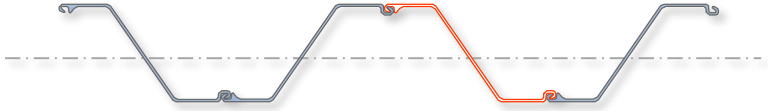
Location



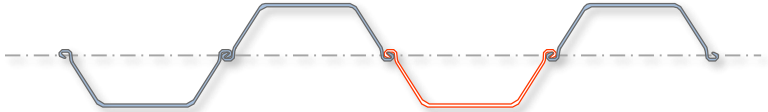
Location

Types of steel sheet piles

Bending resistant

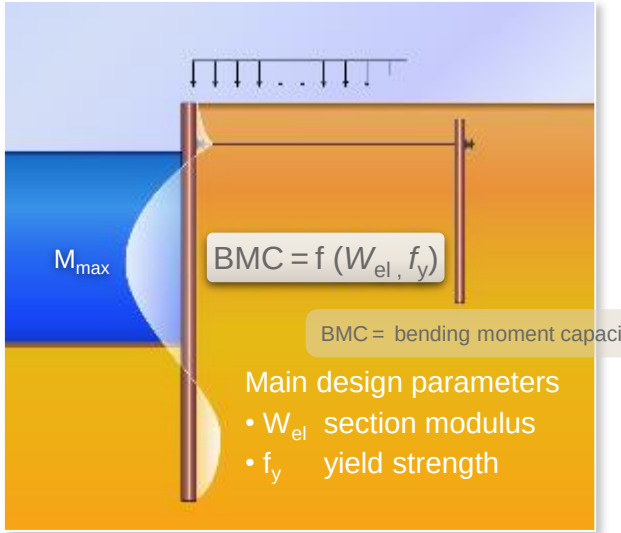


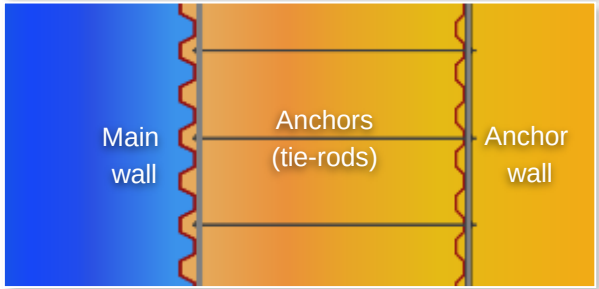
Z - section



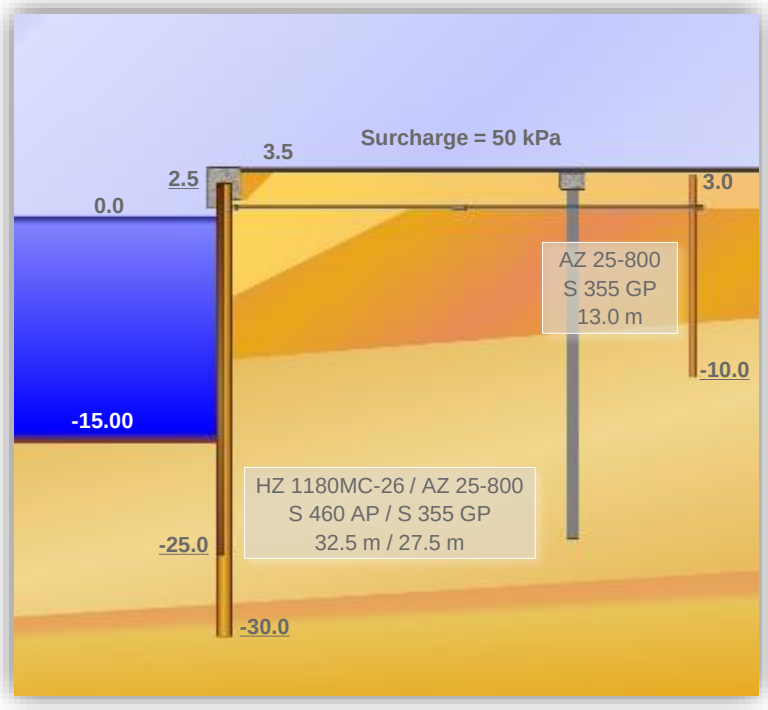
U - section

Combi-wall HZ-M / AZ



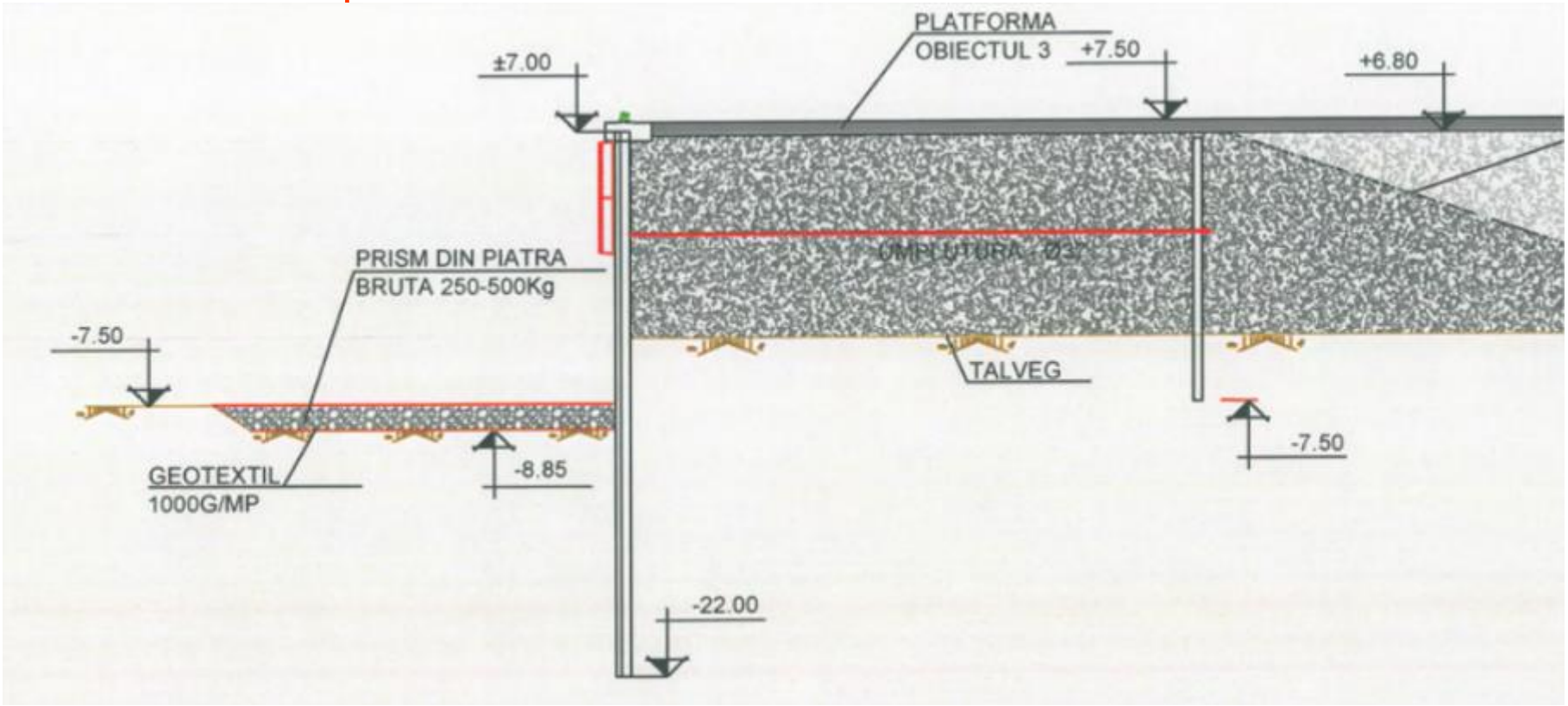


Combined walls. Main applications



- waterfront structures with deep dredge level
- high retaining walls and deep cofferdams
- structures with limited deflection requirements
  (i.e. cantilever walls)

Flat steel sheet piles. AS 500®

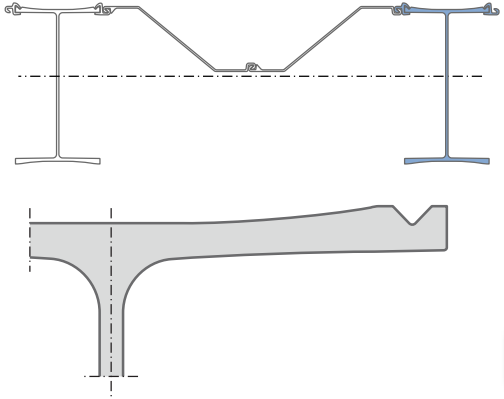


The HZ®-M / AZ® system: components

- HZ-M beam

  wide flange beam with milled groove

  width = 460 mm

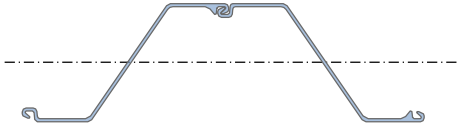


HZM

- connectors

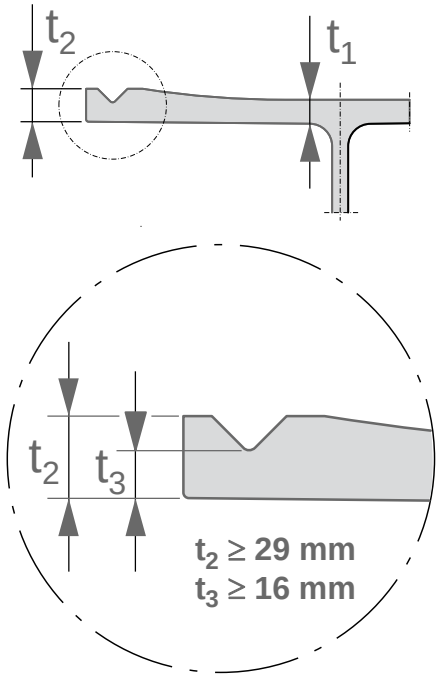
  connectors RZD, RZU, RH

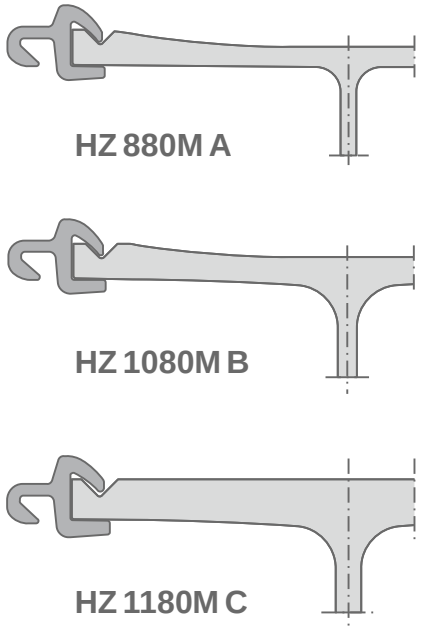
RZU



AZ

Geometry of the flange

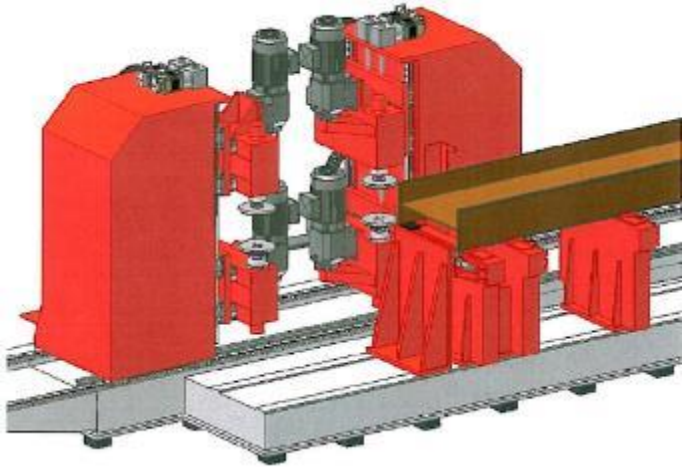


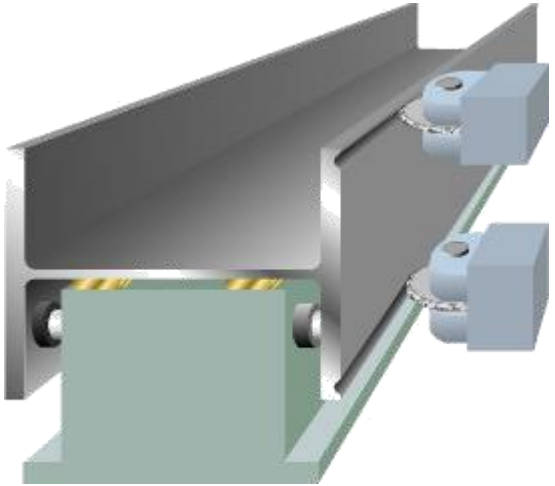


Connectors RZD16 / RZU16 / RH16, except for HZ 1180 C & D

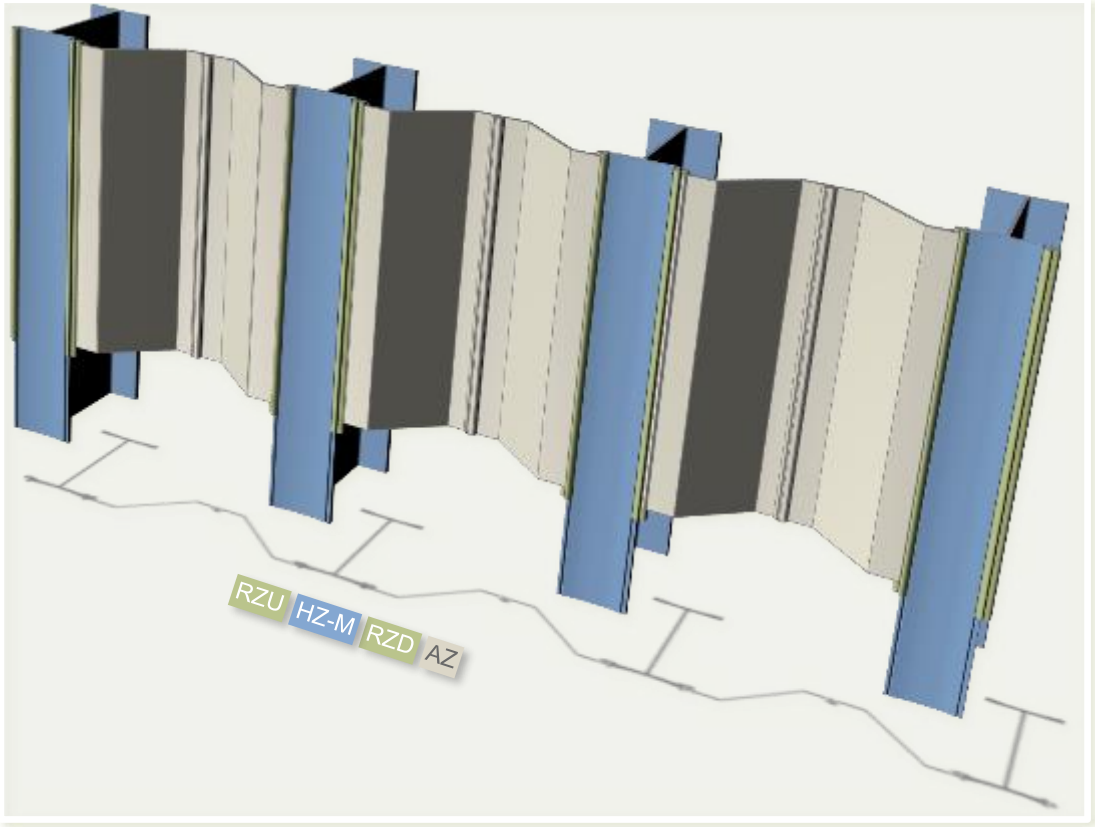
Milling equipment: concept

- two separate & independent devices will mill a groove on one side of the HZ
- milling tolerances: ≤ **1 mm**, to guarantee a minimum thickness of the flange and correct threading of connectors



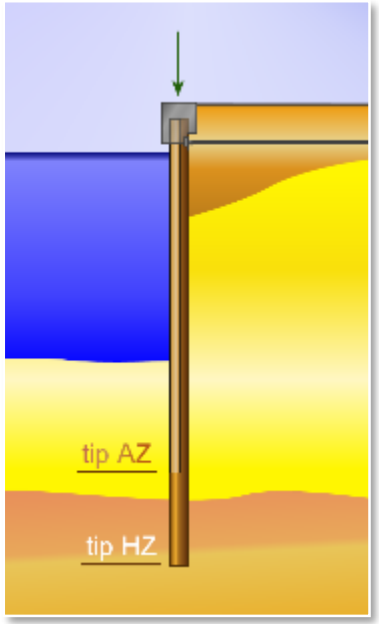


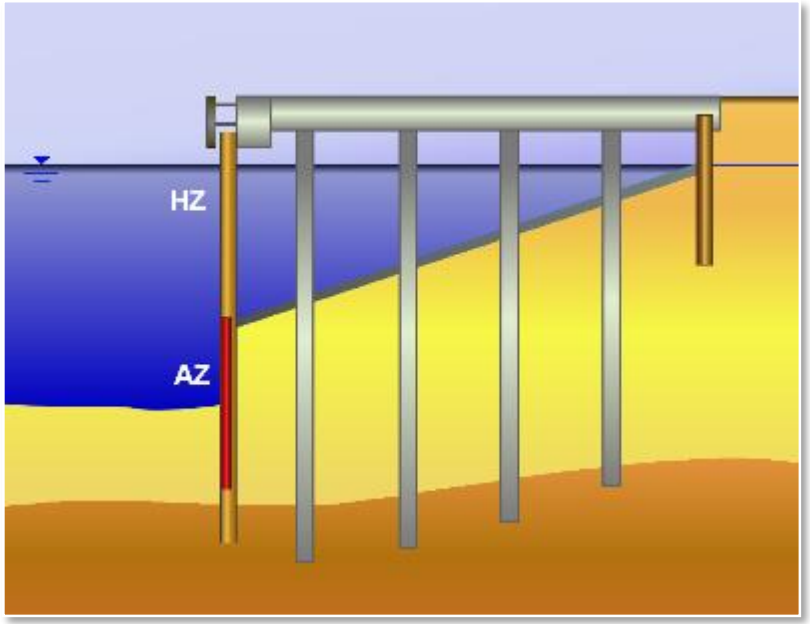
Reduced length of infill sheet piles & connectors



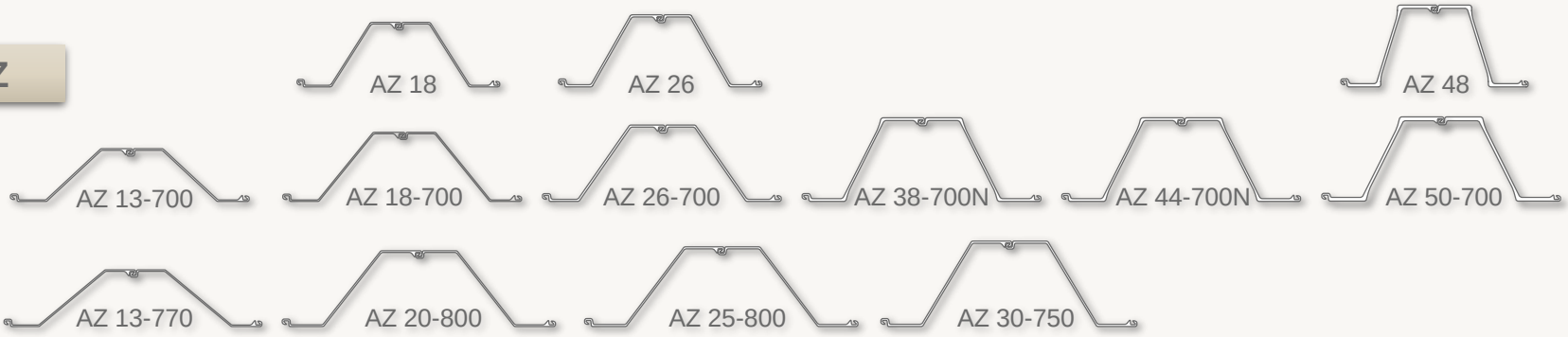
Reduced length of infill sheet piles

- the **shorter** intermediate piles AZ are designed to guarantee wall continuity
  ⇒ weight savings
- passive **3D effect**: design as continuous wall





Z



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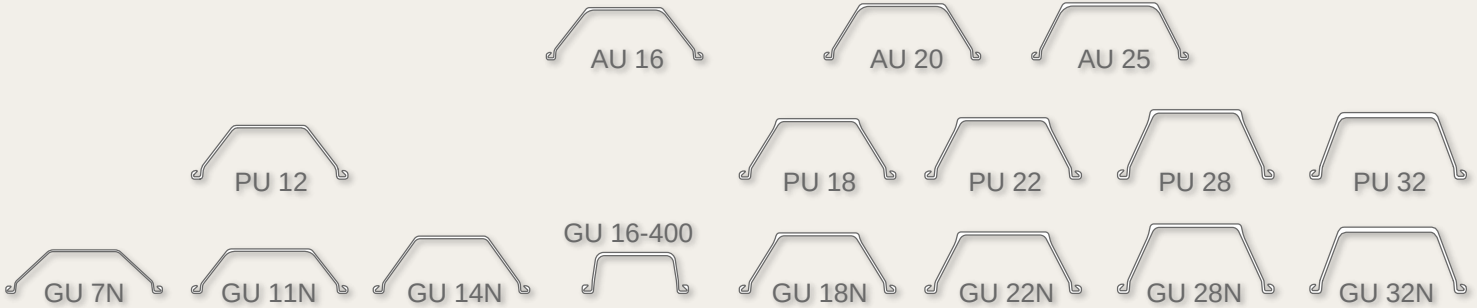


HZ-M

HZ 880M
HZ 1080M
HZ 1180M

Flat

AS 500 - 9.5 / 11.0 / 12.0 / 12.5 / 12.7

Sheet pile range
(September 2017)
W_{el} up to 46 500 cm^3/m

Steel grades. Hot rolled ssp

EN 10248	
	f_y [MPa]
S 240 GP	240
S 270 GP	270
S 320 GP	320
S 355 GP	355
S 390 GP	390
S 430 GP	430

ASTM		
	f_y [ksi]	f_y [MPa]
A 328	39	270
A 572 Gr. 50	50	345
A 572 Gr. 55	55	380
A 572 Gr. 60	60	415

Mill specification*	
	f_y [MPa]
S 460 AP	460

ASTM		
	f_y [ksi]	f_y [MPa]
A 572 Gr. 65	65	450

(*) ArcelorMittal internal mill specification

- Addition of copper 0.35 %, 0.50 %
- ASTM **A 690**: high strength low alloy steel for use in **marine environments** (Gr. 50 and higher available)

Installation of steel sheet piles

Equipment

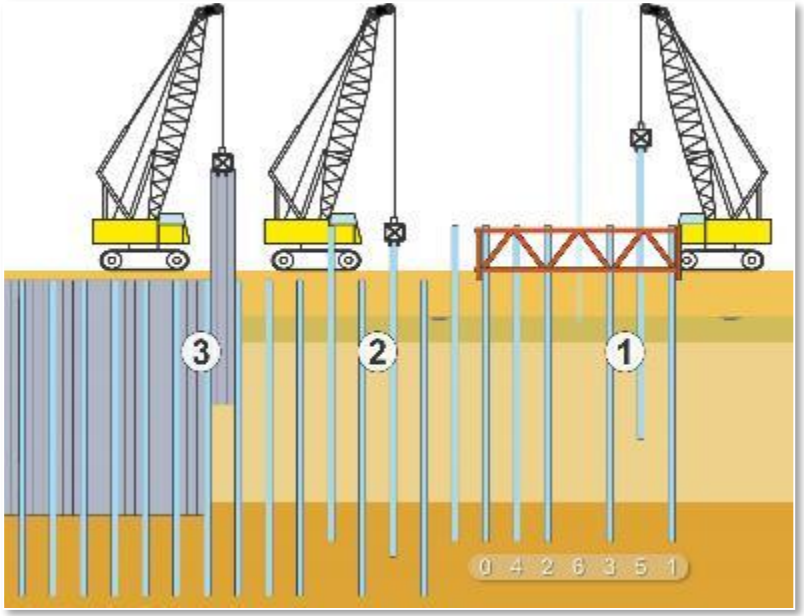
- diesel hammer
- impact hammer (hydraulic, free fall)
- vibratory hammer
- hydraulic press

Accessories

- leader, template, driving cap
- driving assistance:
  - water-jetting
  - pre-drilling
  - blasting

Installation method of combined walls HZ-M/AZ

Driving sequence



AZ infill sheets installed after driving king piles HZM

Durability of steel structures

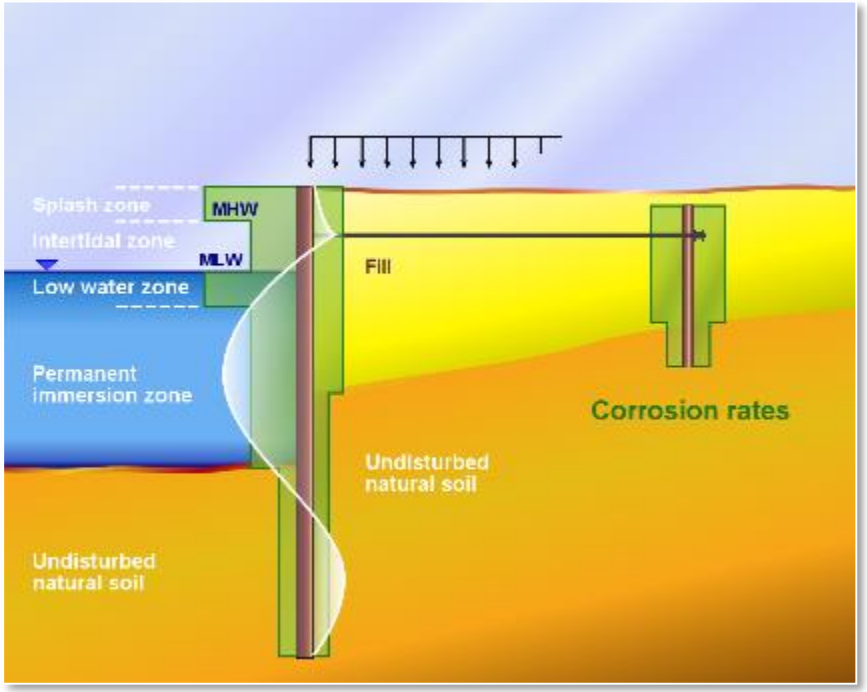
- corrosion in undisturbed natural soils is negligible (exception peat, …)
- in common fresh water, corrosion is low
- in sea water, corrosion has to be considered (splash zone, low water)

Loss of thickness (mm). Table 4.1 & 4.2, EN 1993-5 (2007)

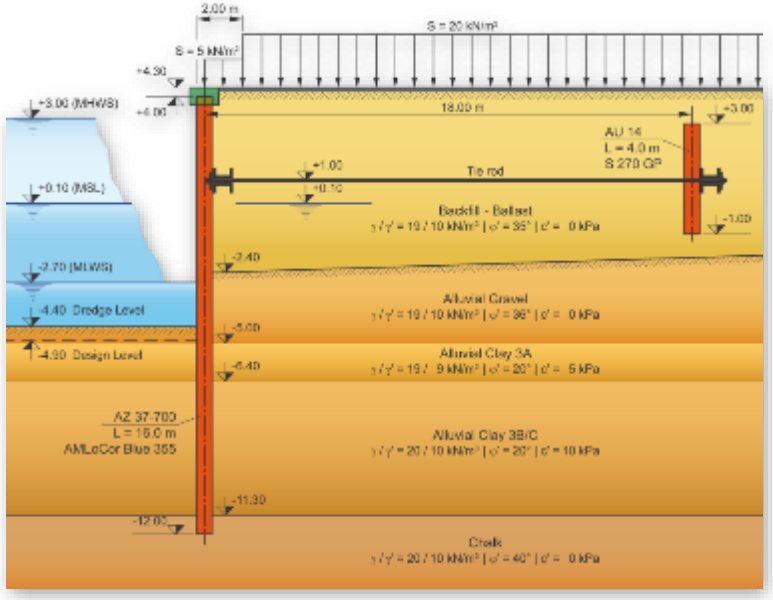
design life (years)	5	25	**50**	75	100
undisturbed natural soils (sand, clay, …)	0.00	0.30	**0.60**	0.90	1.20
common fresh water: waterline	0.15	0.55	**0.90**	1.15	1.40
sea water: permanent immersion & intertidal	0.25	0.90	**1.75**	2.60	3.50
sea water: **splash** & low water zone	0.55	1.90	**3.75**	5.60	7.50

Durability of steel structures. Solutions

- design ssp with maximal bending moment in zone with reduced corrosion rates
- ‘sacrificial’ thickness of steel
- higher steel grade
  ⇒ increases safety factor on steel
- surface protection
  (coating ⇒ aesthetics)
- cathodic protection
  (zones constantly in contact with water)
- concrete capping beam down to 1.0 m below low water



AMLoCor®. The steel of the future… in marine applications



Sheet piles equipped for yearly inspection of the residual thickness over 5 – 10 years

Pilot project. Port of Shoreham, UK (2010)

AZ 37-700,16.0 m long

AMLoCor Blue 355

Unitterminal | Port of Køge | DK (2015 - 2016)

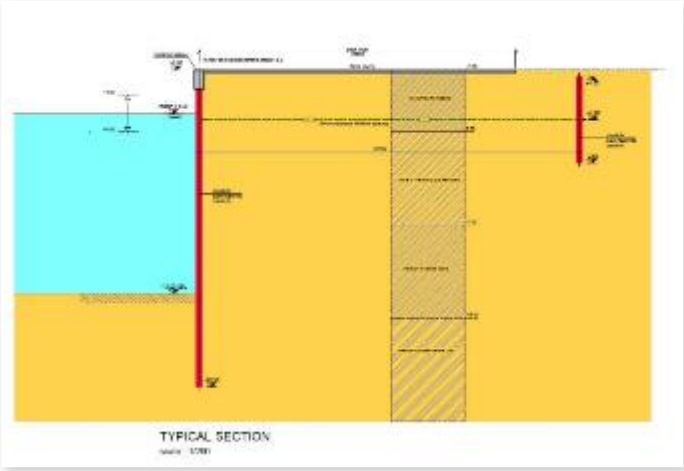
AMLoCor ~ 3 900 t

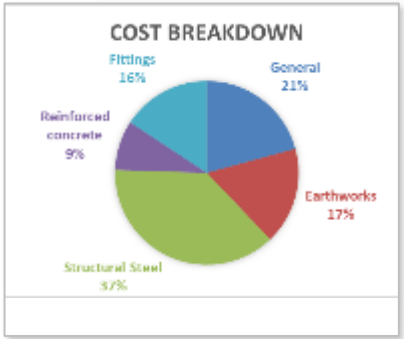
- 1 200 m long berth for container vessels
- dredge level -9.5 m
- AZ 26-700, AZ 38-700N & AZ 42-700N
- up to 22.0 m
- driving equipment: IHC S 70 (hammer)

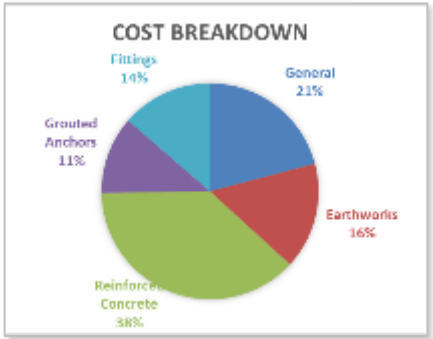
Unitterminal | Port of Køge
Container Terminal
Køge | Denmark

Project Owner	Køge Kommune (Port of Køge), Køge, Denmark			
Design office	Sweco, Denmark (formerly Grontmij / Carl Bro Denmark)			
Contractor	Per Aarsleff A/S, Hvidovre, Denmark			
Sheet Piles	AZ 26-700	AMLocor Blue 390	L=16.5 to 19.0 m	756 t
	AZ 38-700N	AMLocor Blue 355	L=16.5 to 22.0 m	662 t
	AZ 42-700N	AMLocor Blue 320	L=18.0 to 22.0 m	2 506 t
Total	3924 tonnes of sheet piles			
Tie-rods	Ø 43.0 mm	St 670/800	L=7.0 to 18.0 m	4t
	Ø 57.5 mm	St 670/800	L=10.3 to 15.2 m	662 t
Steel beams	HEB 300	S 355 J0+M	L=25.0 m	830t
	UNP 350	S 355 J0+M	L=12.0 to 15.0 m	250 t

Construction cost analysis (by Tractebel in 2018). Key Indicators - Cost







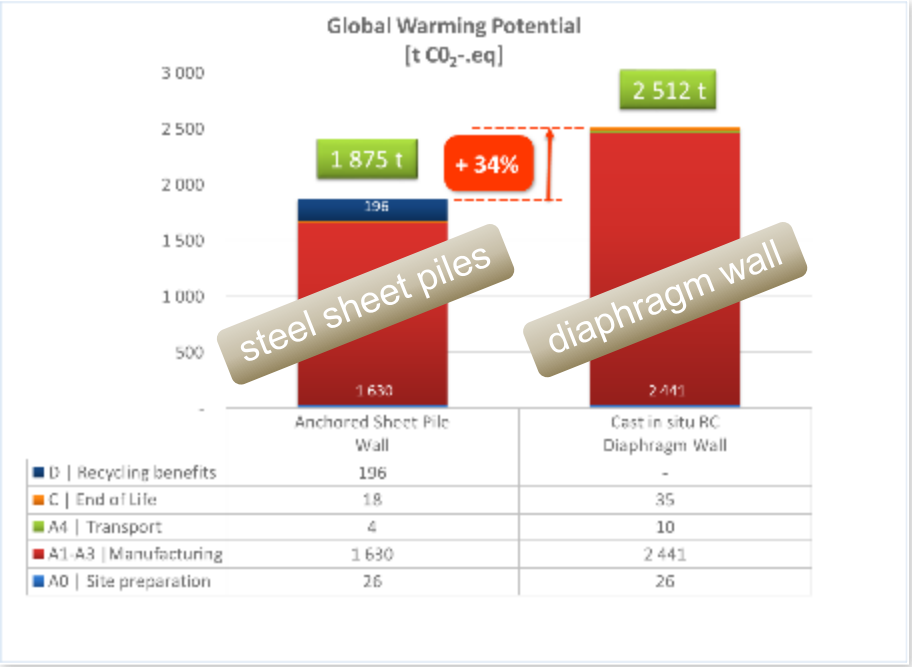
- length quay wall: 200 m
- location: Antwerp (BE)

	Steel sheet piles	Diaphragm wall (RC)
Design activities	7%	
Preliminary activities	15%	
Construction cost	**6.0 M€**	**6.9 M€**

Steel sheet piles: savings **15%**

Construction cost analysis (by Tractebel in 2018). Key Indicators - Life Cycle Cost

- length quay wall: 200 m
- location: Antwerp (BE)
- transport:
  - concrete: 10 km (425 trucks!)
  - steel sheet piles: 270 km by train
- monetization: software DuboCalc (NL)
  ⇒ 50 €/t of CO_2



Projects

Berth 3 | Northport | New Zealand

Recent projects in Ukraine

- **Nikolaev Berth 8 (PU 32)**
  - 1 530 mt
- **Nikolaev (EVT) (HZ-M/AZ)**
  - 1 496 mt
- **Yushni Berth 14 – 16 (HZ-M/AZ)**
  - 5 689 mt
- **Yushni Berth 22 (AU 25 / PU 32)**
  - 1 207 mt
- **Yushni Berth 24 - 25 (AU 25 / PU 32)**
  - 4 360 mt
- **Mariupol 4 (PU 32)**
  - 1 156 mt
- **Odessa Berth 7 (PU 32)**
  - 990 mt

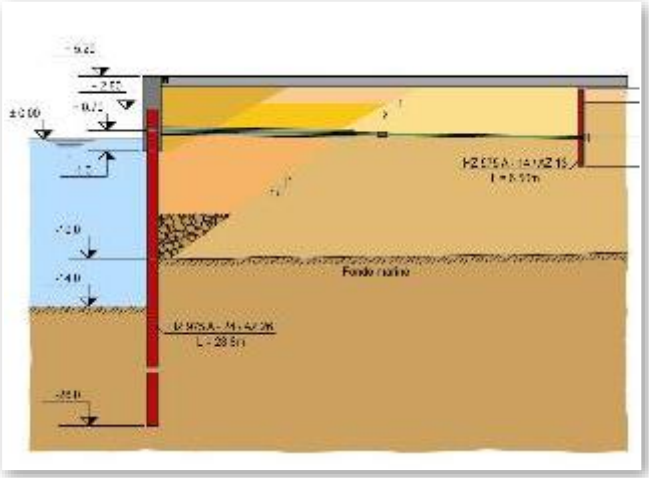
2016 – 2018: ~**18 000 mt**

Cargo Transportation Route (CaTRo) | Kazakhstan (2015 - 2016)

5 400 t of steel foundation products

- PU 12 / PU 28-1 / PU 32+1 coated
- ASDO tie-rods

Puerto de Mejillones | Chile (2002)



Quay wall in a high seismic zone

- HZ 575A-14 / AZ 13
- HZ 975A-24 / AZ 26
- length 6.0 – 28.8 m
- about 5 000 t


ArcelorMittal
Thank you for your attention …
Dover Western Docks Revival | UK (2018)