



ArcelorMittal



Information and Case Studies on the use  
of the AZ 750 and AZ 800 Series

DSI, Dansk Spuns & Rammedag, August 2017, Aarhus

# Presentation Outline



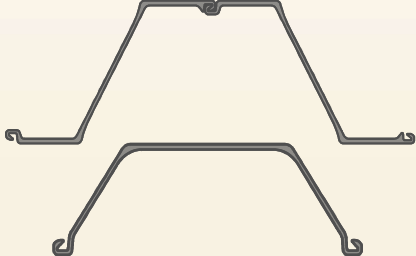
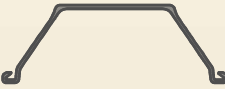


- AZ 750 & AZ 800 Installation Guidelines and Examples
- Further Developments in ArcelorMittal Sheet Piling

# Hot Rolled Steel Sheet Piling

## ArcelorMittal mills and product range

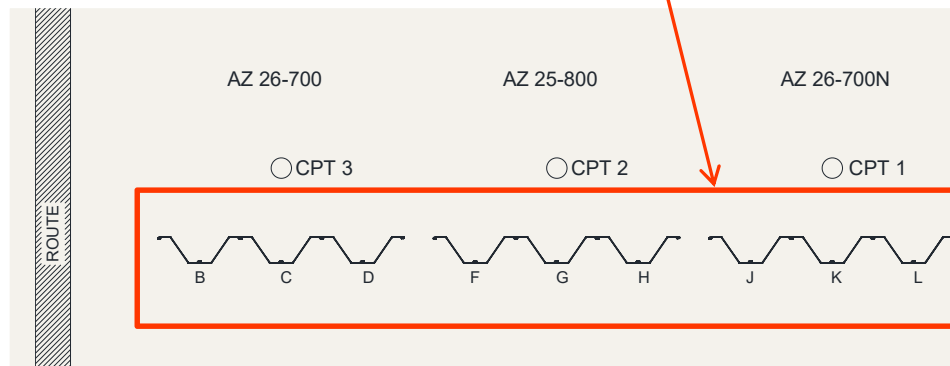
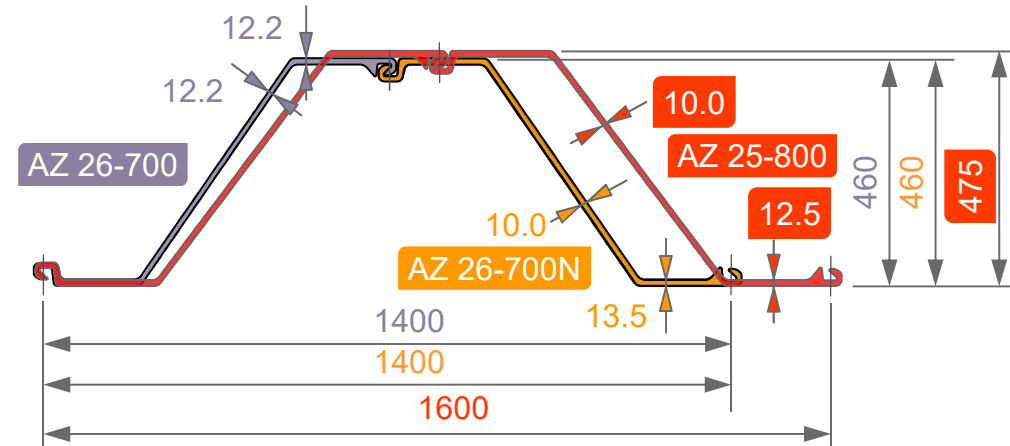


\* depending on product mix    \*\* Fabrication capacity

Mill	Capacity
Belval	620 kt
	AZ
	PU-600
	AU-750
Dabrowa	200 kt *
 	GU-400
	GU-600
Differdange	70 kt **
	
	HZM



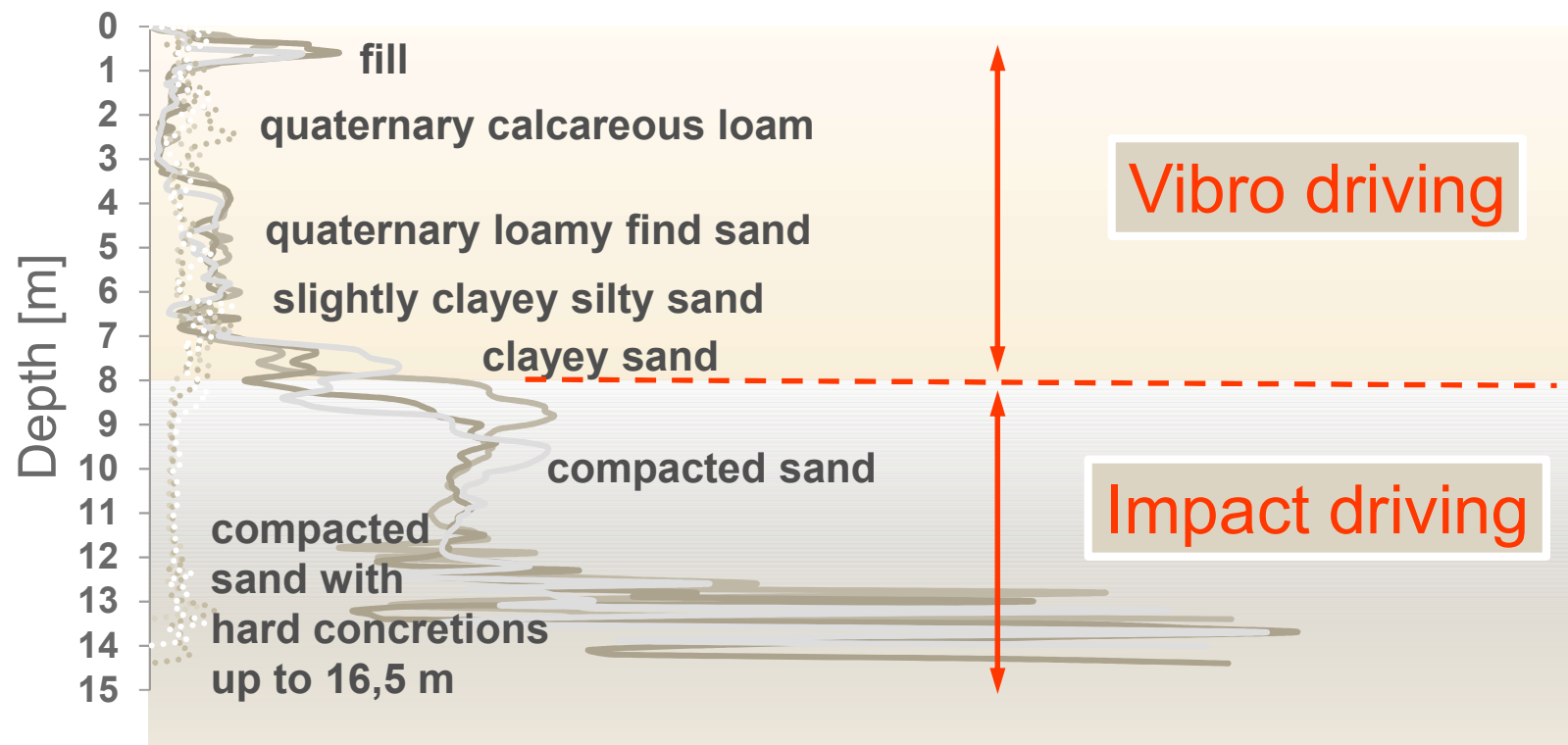
# Driving test in Limelette, Belgium. Set-up.





## Soil conditions and installation method

Very hard soil from 8 m depth



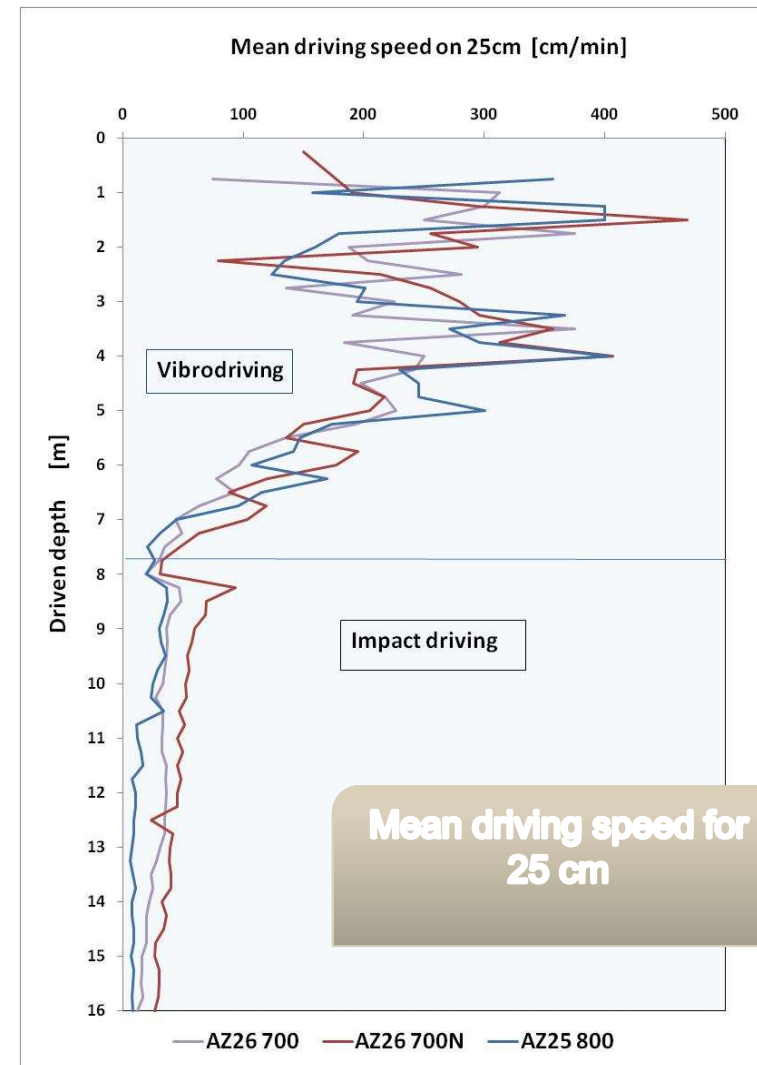


ArcelorMittal

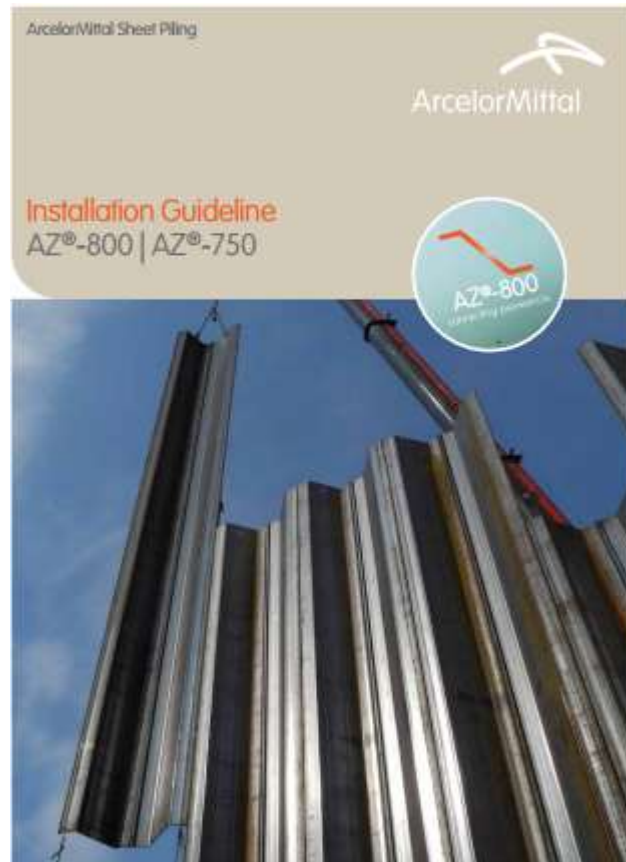
## Analysis of driving speed

driving speed behaviour is similar for the 3 profiles

- for vibrodriving (0  $\Rightarrow$  8m depth)
- for impact driving (8m  $\Rightarrow$  16m depth)



# Further data on driving results of the new AZ 75 & AZ 800 series



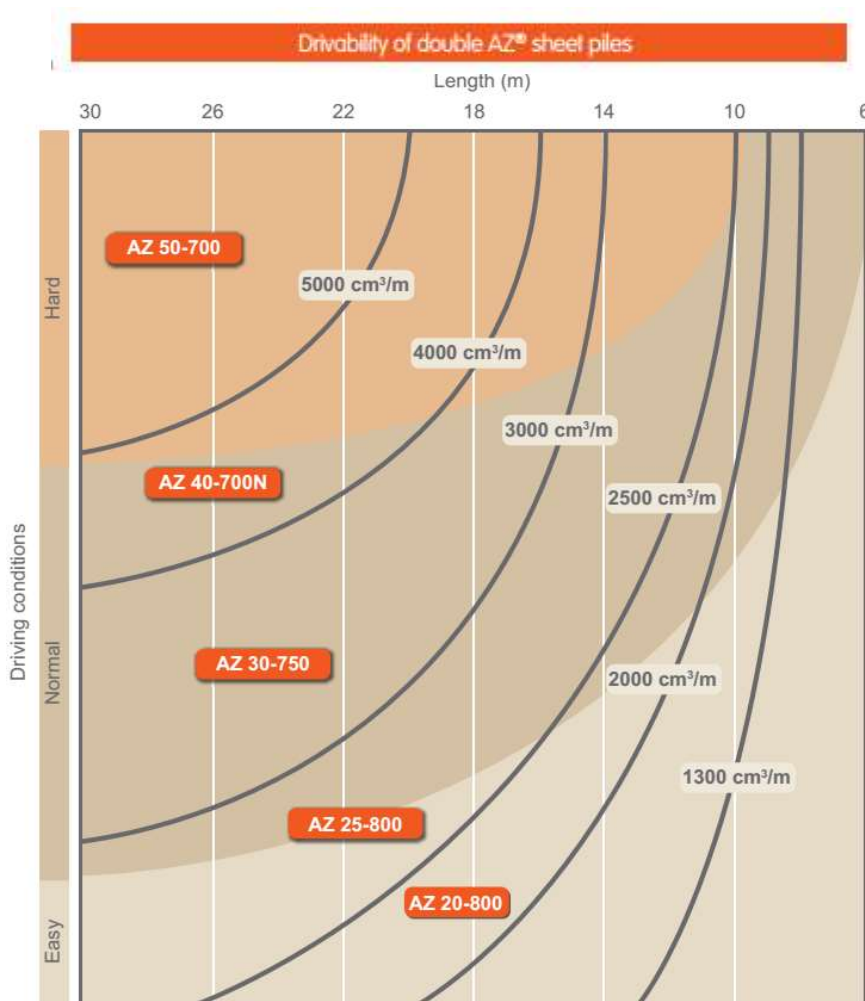
- Choice of Section
- Installation Methods
- Soil Conditions
- Examples





ArcelorMittal

# Choice of Section



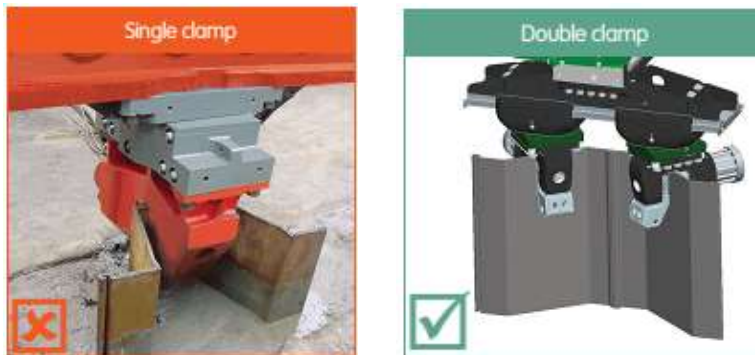
## Soil definitions

	SPT value (blows)		CPT value (in MN/m <sup>2</sup> )	
	Cohesive	Non-cohesive	Cohesive	Non-cohesive
Easy	0 - 5	0 - 20	0 - 0.5	0 - 7.5
Normal	5 - 15	20 - 40	0.5 - 1	7.5 - 15
Hard	> 15	> 40	> 1	> 15

- Rule of thumb: The recommended sheet pile length (in cm) corresponds to the section modulus (in cm<sup>3</sup>/m)
- For AZ 800 sections more surface friction to be expected than equivalent AZ 700 sections.

## Installation with vibratory hammer

- Dimensioning of piling equipment
- Single Clamp vs Double Clamp



- Clamping force

## Installation with impact hammer

- Correctly sized driving cap is essential



- Driving caps available for all AZ 750 and AZ 800 sections



## Installation by pressing



- Limited width for the self walking press
- Available systems for leader guided pressing system

# Chantry Cottages – Goole (UK 2015)

## Flood Protection, approx. 1300t



### Section

- AZ 30-750, L=11m, S355GP

### Equipment

- Vibratory Hammer / Single Clamp

### Soil Conditions

- Sand, clay, SPT 20-30 blows

### Productivity

- 20 piles per day

# Haven 22– Lauwersoog (NL 2016)

## Quay Wall, approx. 670t



### Section

- AZ 30-750, L=20m, S430GP

### Equipment

- Vibratory Hammer / Single Clamp

### Soil Conditions

- Silty sand, SPT 30-40 blows

### Productivity

- 15 piles per day



# Weschnitzdeich – Biblis (DE 2016)

## Flood Protection, approx. 1500t



### Section

- AZ 20-800, L=9-12m, S240GP

### Equipment

- Vibratory Hammer / Double Clamp

### Soil Conditions

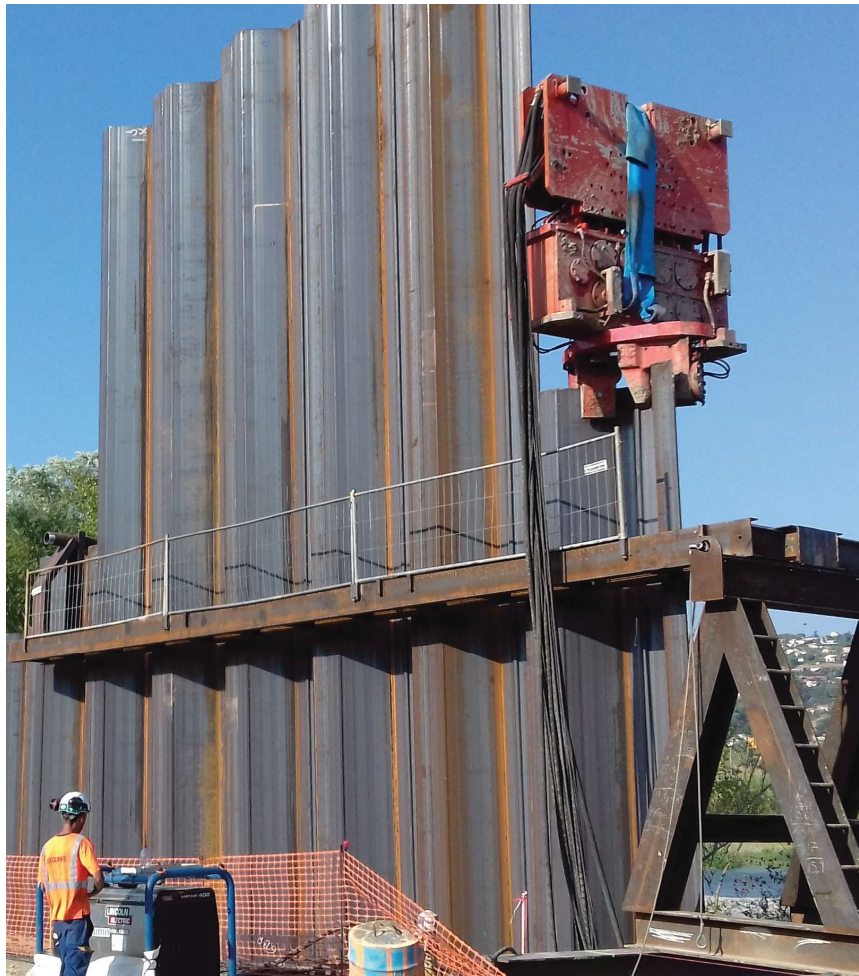
- Backfill (loose) sand, SPT 10-20 blows

### Productivity

- 20-30 piles per day

# Saitn-Laurent-du-Var (FR 2016)

## Flood Protection, approx. 2590t



### Section

- AZ 20-800(-0.5)
- AZ 23-800
- AZ 25-800, L=15m, S240GP

### Equipment

- Vibratory Hammer / Single & Double Clamp
- Diesel hammer with AM driving cap

### Soil Conditions

- Backfill (compact) sand, SPT > 45 blows

### Productivity

- Not available



# Bocholt (BE 2016)

## Canal rehabilitation, approx. 2740t



### Section

- AZ 20-800, L=6 & 8m, S355GP

### Equipment

- Vibratory Hammer / Single Clamp

### Soil Conditions

- Sand (loose), Clay (soft)

### Productivity

- Up to 25 piles per day



# Quarleshaven - Vlissingen (NL 2016)

## Quay Wall, approx. 400t



### Section

- AZ 23-800, L=23m, S355GP

### Equipment

- Vibratory Hammer / Double Clamp

### Soil Conditions

- Dense sand with stones, stiff clay

### Productivity

- 8 piles per day

# “Spiegel/Mirroi” Car Park – Brussels (BE 2016)

## Permanent Wall 3 storey car park, approx. 450t



### Section

- AZ 27-800, L=6.5-16m, S355GP

### Equipment

- Placed with Vibratory Hammer

### Soil Conditions

- Sandy silty clay

### Productivity

- Not available



# Follobanen – Oslo (NO 2016)

## Railway, approx. 2900t



### Section

- AZ 23-800, L=18m, S430GP

### Equipment

- Vibratory Hammer / Pressing

### Soil Conditions

- Soft clays in upper layers /  
granite in lower

### Productivity

- Up to 16 piles per day

# Zeeland (NL 2016)

## Pile driving test



### Section

- AZ 20-800, L=16m, S430GP
- AZ 25-800, L=16m, S430GP

### Equipment

- Resonator

### Soil Conditions

- Clays and sand, medium dense soil

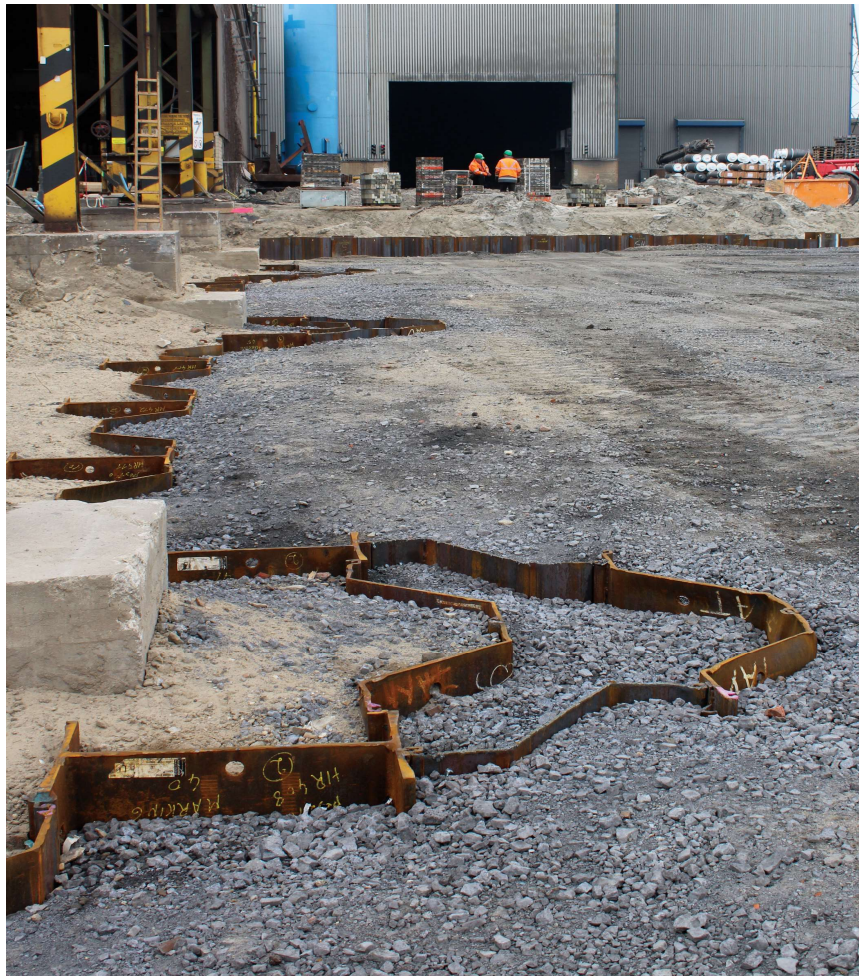
### Productivity

- Successful pile driving test with new resonating pile driving method



# Steel Mill – Hambourg (DE 2017)

## Foundation works retaining wall, approx. 240t



### Section

- AZ 25-800, L up to 20.8 m, S240GP

### Equipment

- Vibratory Hammer / Hydraulic drop hammer

### Soil Conditions

- Sand, medium dense soil

### Productivity

- Not available



Amsterdam (NL 2017)

Canal embankment and retaining wall, approx. 1200t



ArcelorMittal



## Section

- AZ 18-800 & AZ 25-800, L up to 17.8 m, S240GP

## Equipment

- Pressing system

## Soil Conditions

- Loose to medium dense sand, reclaimed

## Productivity

- 8 piles per day

# Cape Town (RSA 2017)

## Driving Test



### Section

- AZ 25-800, L=12.0 m, S430GP

### Equipment

- Vibratory hammer / single clamp

### Soil Conditions

- Fine sand, SPT 45 blows

### Productivity

- Not available

## Further Developments in ArcelorMittal Sheet Piling



- BIM Downloads
- Durability\_3.5.2.145 (July 2017 version)
- Environmental Product Declaration 2016
- GU10N / GU11N / GU12N Sections
- Case Studies

Thank you for your attention ...



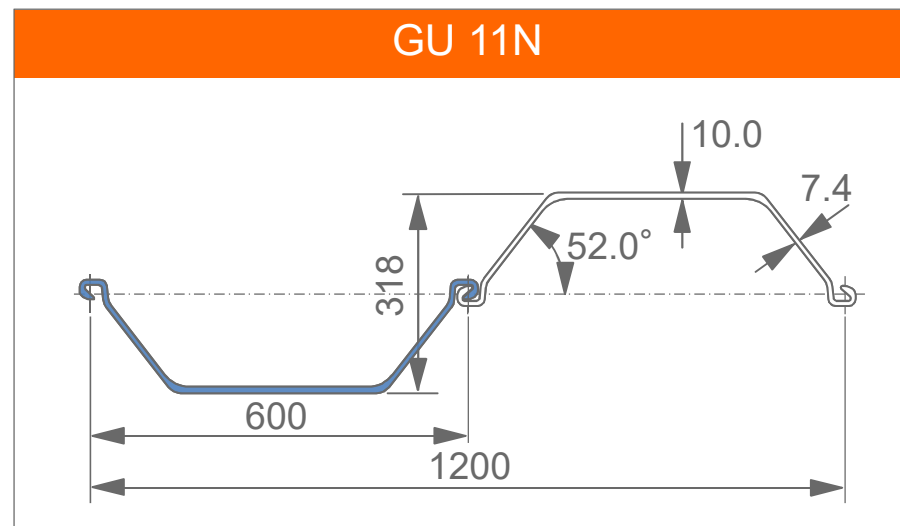
... and let's stay connected

Back up





# GU 11N (Jan. 2017)



	h (mm)	t (mm)	s (mm)	$W_{el}$ (cm <sup>3</sup> /m)	G (kg/m <sup>2</sup> )
GU 10N	316	9.0	6.8	990	93.0
<b>GU 11N</b>	<b>318</b>	<b>10.0</b>	<b>7.4</b>	<b>1 095</b>	<b>100.4</b>
GU 12N	320	11.0	8.0	1 200	107.7

# Project Follobanen

The project is currently the largest transport project in Norway and includes the country's longest railway tunnel (20 km). Combined with the existing Østfold Line, four tracks to the capital Oslo will represent more trains and faster trains on schedule.





ArcelorMittal

## Project Follobanen

- currently Norway's largest transport project
- 22 km new double track line from Norway's capital to the public transport center of Ski
- includes extensive works at Oslo Central Station and the construction of a new station at Ski
- will comprise the construction of around 64 km new railway tracks
- will comprise a 20 km long tunnel; Norway's longest railway tunnel to date and the longest rail tunnel in the Nordic countries
- to be excavated mainly with tunnel boring machines (TBM) - the first long railway tunnel in Norway with separate twin tunnels
- provides increased traffic capacity to and from Oslo
- will enable a 50 % reduction in journey time between Oslo and Ski
- designed for speed up to 250 km/h
- EPC contracts
- scheduled for completion in the end of 2021

# Project Follobanen





# Project Follobanen



AZ 800 installed with vibro





# Project Follobanen

**AZ-700 installation with  
pressing**



# Project Follobanen



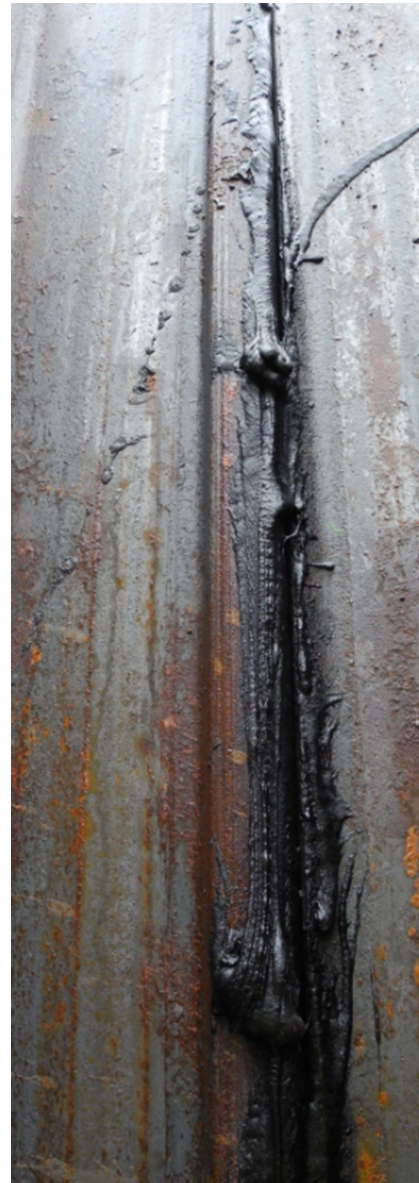


# Project Follobanen

**Measuring  
inclination**



**BELTAN  
sealant**



# Project Follobanen



**Special pile  
fabricated on-site**

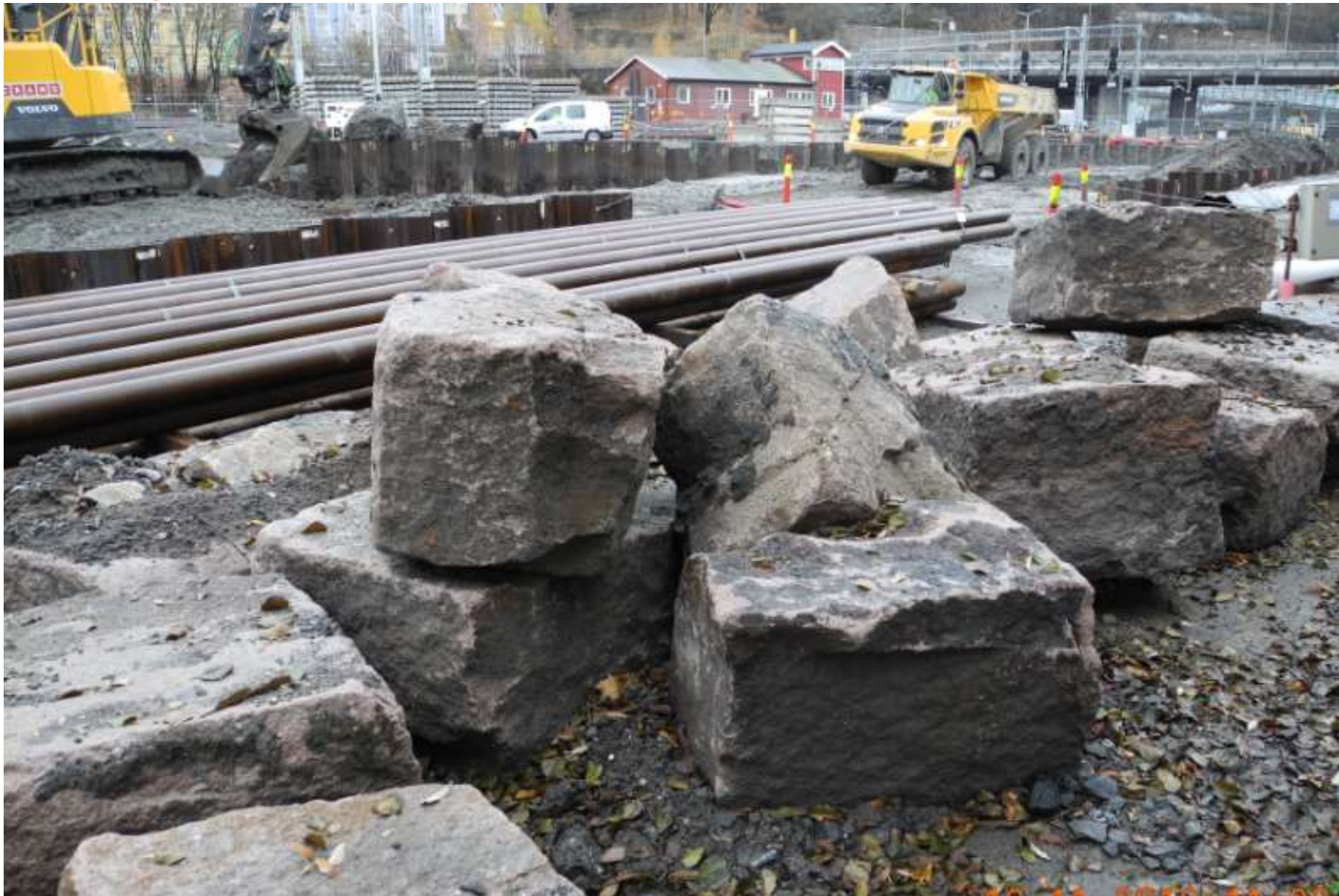


ArcelorMittal



# Project Follobanen

Obstacles in the  
ground



# Project Follobanen

Ground  
improvement by  
soil mixing





# Project Follobanen



ArcelorMittal



Note proximity of buildings

# Project Follobanen





# Project Follobanen



# Project Follobanen



ArcelorMittal





# Project Follobanen



ArcelorMittal



# Project Follobanen





# Project Follobanen



- Sheet piles instead of slurry walls to minimize excavation
- containment of old contamination from Railway workshop
- multiple splicing of sheet piles up to 54m length
- sealing with Beltan
- Rockbolting
- intensive measurements of vibration and settlements
- installation by vibrating (ICE 23RF & 28RF, ABI, RTG RG19+MRV105)  
and pressing (van T'heck, NL)
- soft clays, with hard moraine lenses
- stray currents have been considered in the design of the sheet pile walls
- temporary and permanent use of SSP

# Environmental Product Declaration

## ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	ArcelorMittal Commercial RPS S.à r.l.
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-ARM-20160125-IBD1-EN
Issue date	20/09/2016
Valid to	19/09/2021

**Hot-rolled steel piling**  
**ArcelorMittal Sheet Piling**

[www.bau-umwelt.com](http://www.bau-umwelt.com) / <https://epd-online.com>

