

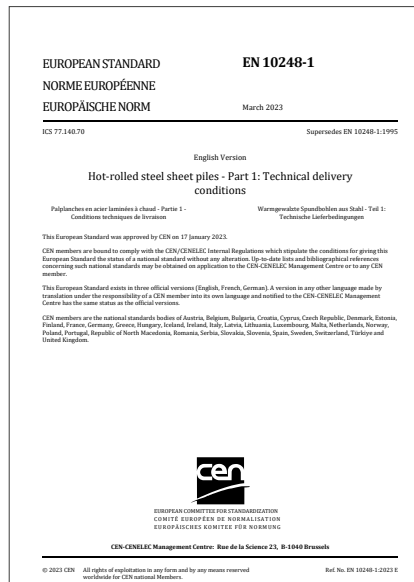


# Steel Foundation Solutions

General Catalogue 2024

**New standard**  
EN 10248 - Part 1: 2023

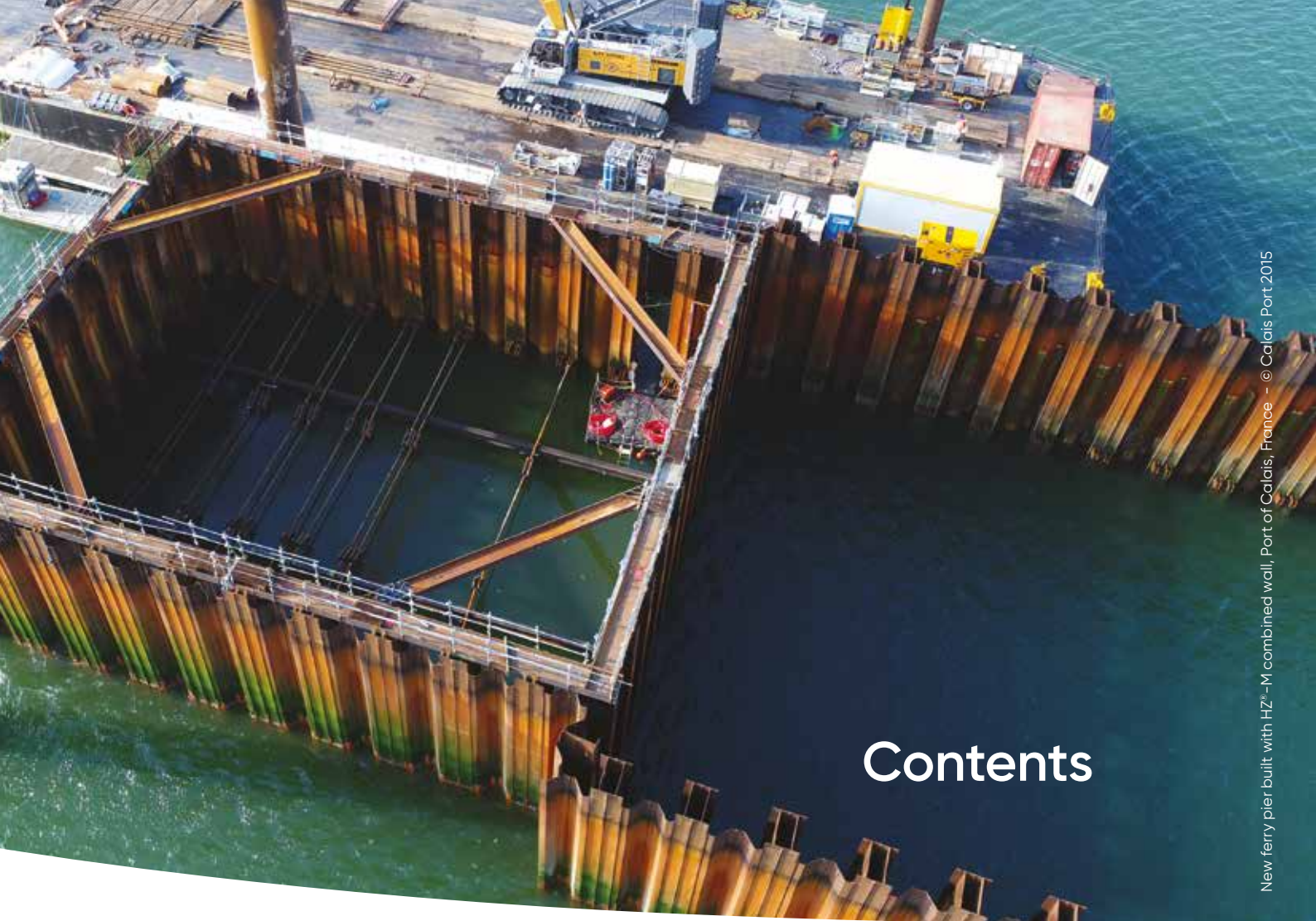




## Standard EN 10248-1:2023 - new version

In comparison with the previous edition of 1995, the following technical modifications have been made:

- a) Document was restructured;
- b) Normative references were updated;
- c) Grades S460 and S500 in quality GP were introduced;
- d) Modification concerning the maximum values for the chemical composition;
- e) Addition of 7.4.3 dedicated for hot-dip zinc-coating and 7.8 for load bearing capacity;
- f) New wording for Clauses 8, 9 and 10 for inspection and testing;
- g) Addition of Clause 12 on the complaints;
- h) Removal of the former Annexes B and C on Euronorms and equivalent designations;
- i) Addition of the Annexes B, C, D and E.



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## Water transport solutions

Build sustainable and durable maritime port and waterway infrastructures with our steel solutions. Quay walls made with steel sheet piles allow up to **20% faster construction and 15% lower cost\*** when compared with alternative materials. Steel is also the material of choice for breakwaters, dolphins, locks and canals.

The lifetime return on investment of ports built with ArcelorMittal AZ® steel sheet piles exceeds by 8%\* the financial result brought by concrete solutions. **AMLoCor® steel grades are up to 5 times more corrosion-resistant** than standard steel grades, allowing optimised designs with service life of up to 100 years.

A specific Environmental Product Declaration based on comprehensive Life Cycle Analyses is available for ArcelorMittal steel sheet piles and EcoSheetPile™ Plus made of 100% recycled steel and with 100% renewable electricity. With the intrinsic ductility of steel, sheet piling solutions in conjunction with modern performance-based design methods help design and optimise safe ports in seismic areas.

\* Results from a study by Tractebel, Belgium (2019).

### Water based transport is essential to our global economy



Water Transport Solutions

Ribécourt, France. © NGE Fondations

## Hazard protection solutions

Dykes, flood and erosion protection barriers made with steel sheet piles are one of the most efficient ways of protecting against floods and rising sea levels.

A new design method for reinforcements and upgrades of existing flood protection systems using steel sheet piles leads to **up to 40% savings\***.

Requiring little equipment and manpower, **steel sheet piles can be quickly installed** with guaranteed quality, even in remote locations.

AZ®-800, the widest sheet piles on the market, allow up to 14% less installation time. Dixeran® declutching detectors ensure against the loss of integrity of a sheet pile wall. Sealing systems such as AKILA® improve the imperviousness of the structures.

\* Recent study by multi-disciplinary research team in the Netherlands (POV MacroStability, 2020).

### Safeguarding our communities from natural disasters



Hazard Protection Solutions

Flood protection barrier protecting the city of St-Pierre de Gaubert, France



## Mobility infrastructure solutions

Composite bridges with steel sheet pile abutments have **up to 10% shorter construction time and up to 15% less economic impact** on the community throughout their service life<sup>\*</sup>. The use of steel sheet piles as load-bearing impervious permanent retaining walls in underground car parks maximizes the available surface inside the building.

Permanent steel sheet pile walls in underground car parks of 2 to 3 levels are **up to 50% more cost-effective\*\*** than walls built with alternative materials, with significantly shorter execution time.

Silent and low vibration installation techniques minimise disruption in urban settings. **Steel sheet piles can be reused several times and are recyclable**, reducing the global environmental impact of projects.

<sup>\*</sup> Study by Karlsruher Institut für Technologie (KIT), Germany (2019).

<sup>\*\*</sup> Study by Royal Haskoning DHV, the Netherlands (2019).

**Efficient and reliable mobility infrastructures make your journey smoother and safer**



Mobility  
Infrastructure  
Solutions

Underground car park with permanent steel sheet pile walls at Hopmarkt shopping center, Aalst, Belgium

## Environmental protection solutions

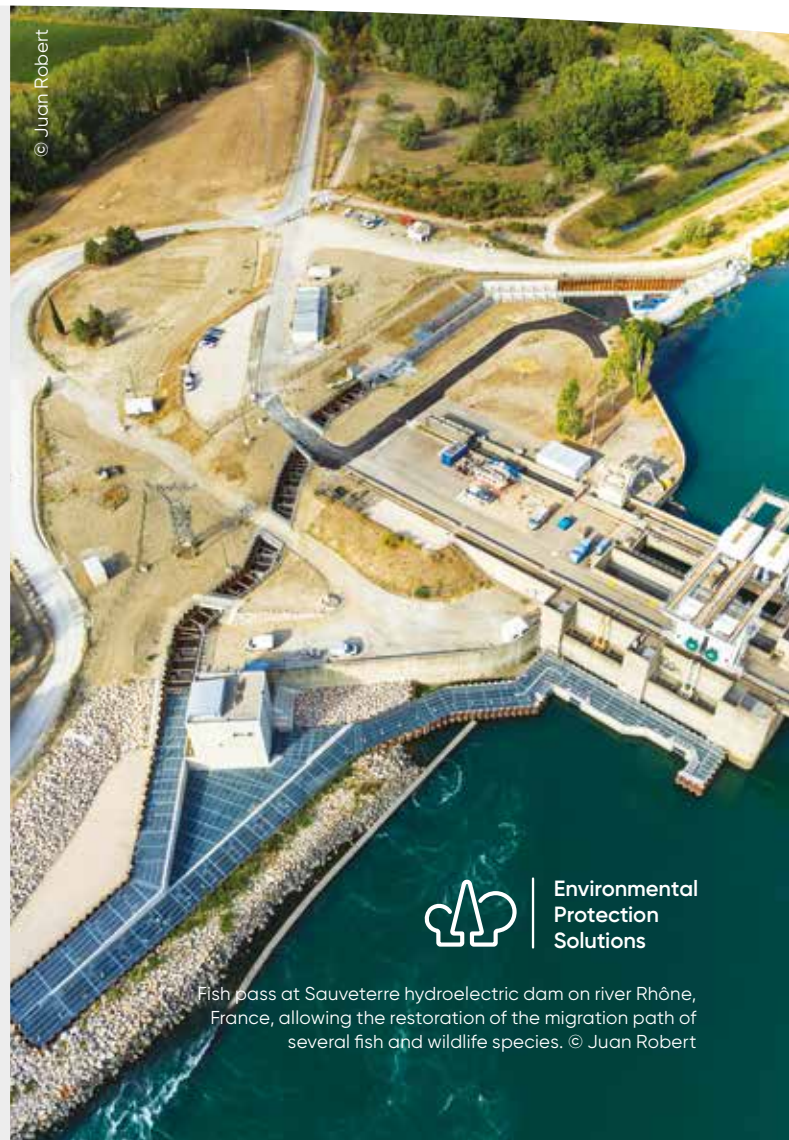
Steel sheet piles are used as temporary and permanent retaining walls for landfill conversion, polluted soil remediation, riverbed cleaning operations and pollution containment. **Sealing systems such as AKILA® ensure the retaining walls are impervious**, while suitable for contact with groundwater.

Enclosures retaining contaminated soils can be created even faster with the **unique 800 mm wide AZ®-800** steel sheet piles.

ArcelorMittal EcoSheetPile™ Plus has a much lower carbon footprint than other steel sheet piles\*. This product range is the ideal solution to reduce the environmental impact of all retaining walls.

<sup>\*</sup> Environmental Product Declaration for EcoSheetPile™ Plus (2021), based on a life-cycle analysis with "cradle-to-gate with options" methodology.

**When faced with pollution risks, containment is vital**



© Juan Robert



Environmental  
Protection  
Solutions

Fish pass at Sauveterre hydroelectric dam on river Rhône, France, allowing the restoration of the migration path of several fish and wildlife species. © Juan Robert

# Introduction

ArcelorMittal is the world's leading steel and mining company. ArcelorMittal is also the world's largest manufacturer of sustainable hot-rolled steel sheet piles. ArcelorMittal Sheet Piling oversees the sales, marketing and promotion of foundation solutions that include the following products manufactured in these ArcelorMittal mills:

- hot rolled steel sheet piles: Belval and Differdange in Luxembourg, Dabrowa in Poland;
- cold formed steel sheet piles: "Palfroid" in Messempré, France;
- steel tubes (for foundations): Dintelmond, The Netherlands (for EU markets);
- steel bearing piles: Belval and Differdange in Luxembourg.

ArcelorMittal Sheet Piling offers a complete solution package, that includes also accessories (such as anchoring material, walers, fabricated piles, driving caps, etc.) with a full technical support from the conceptual design to the final installation process and additional features and services (such as special fabrications, coating, sealant material for the interlocks, etc).

ArcelorMittal Belval is the world's largest rolling mill of hot rolled steel sheet piles and has been playing a leading role in the development of piling technology for over 100 years. The first steel sheet piles were rolled in 1911 and 1912: the "Ransome" and "Terre Rouge" piles. Since then, the product range of ArcelorMittal's mill in Belval has undergone constant improvement and development to include AZ® sections up to 800 mm wide and U-type sections up to 750 mm wide (AU). One rolling mill in Belval is dedicated solely to the production of steel sheet piles.

ArcelorMittal Differdange produces the large HZ®-M sections to form the most competitive HZ/AZ high section modulus combined wall system.

ArcelorMittal Dabrowa manufactures a wide range of hot rolled U-type sheet piles.

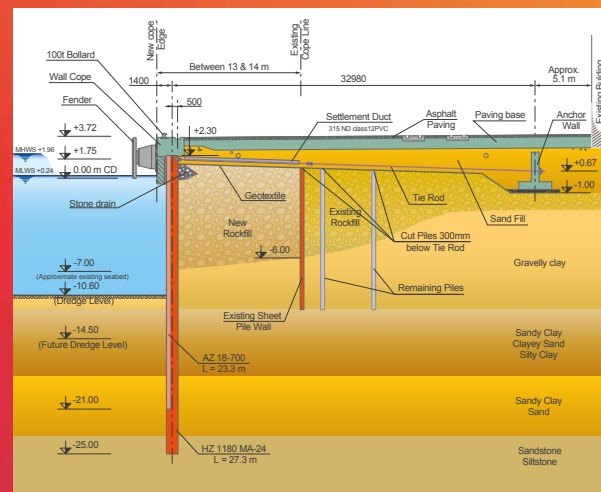
ArcelorMittal steel sheet piles are manufactured in Europe. Our values are sustainability, quality and leadership. We offer the most complete range of products and services, focused on bringing the most to our customers. ArcelorMittal Sheet Piling provides cost-competitive solutions and certified quality for its customers, while considering society's expectations for a more circular and less carbon-intensive economy.

ArcelorMittal's piling series are especially suitable for quickly and reliably building cost-effective structures. They are characterised by excellent section properties, for instance a highly competitive ratio of section modulus to weight, as well as high moments of inertia. Steel sheet piles and foundation products are manufactured according to the European standards, but they can also be supplied according to other international standards (e.g. ASTM).

**Decarbonisation** is the most important aspect of ArcelorMittal's long-term strategy. For several years already, the EcoSheetPile™ range has been produced from 100% recycled, recyclable and reusable steel. It is a major contributor to the circular economy.

Launched in 2021, the new **EcoSheetPile™ Plus** brand, essential part of ArcelorMittal's **XCarb™ recycled and renewably produced** initiative to reach carbon neutrality by 2050, is made from recycled material with additionally 100% renewable electricity.

As project owners start integrating green credentials assessment rules in their tendering processes with fair monetization processes, bids that offer sustainable construction solutions with a reduced carbon footprint have a tangible advantage.



Preliminary design for a quay wall



Belval steel works, Luxembourg, 1930s



Sheet pile catalogues, 1912

## Design office and technical assistance

Our technical experts offer a comprehensive service and outstanding support to all parties involved in the design, specification and installation of sheet and bearing piles.

The in-house Design Department offers the creation of preliminary designs, including anchorage and corrosion assessment. Using our extensive in-house knowledge of products, grades and design concepts, we support designers to achieve the most efficient design and competitive piling solution for their project, including focusing on carbon footprint reduction using Life Cycle Assessment method.

We also provide software to help design steel sheet piling solutions.

The Technical Department assists with project planning, logistics, design of driving layout plans and installation templates, quality certifications, selection of driving equipment, installation support and on-site expertise.

Our technical experts regularly teach at universities and design consulting offices. They also share their experience at geotechnical and specialised technical seminars throughout the world.

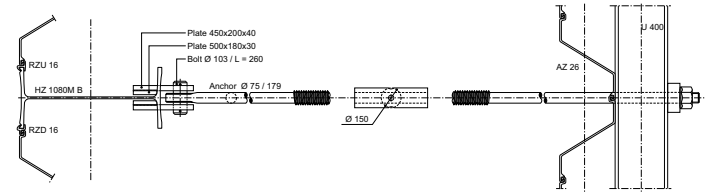


## Customised solutions

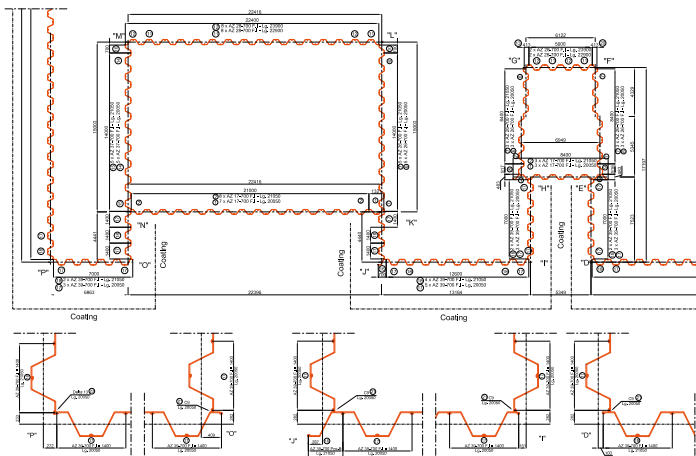
ArcelorMittal Sheet Piling provide customised products and solutions that best fit the project requirements. We design and manage special fabrications and ensure on-time delivery to the construction sites.

We can modify the length, width and shape of sheet piles and bearing piles through bending, cutting and welding. We can assemble box piles and corner sections, weld connectors, interlocks and pile toe reinforcements, bore drainage or lifting holes.

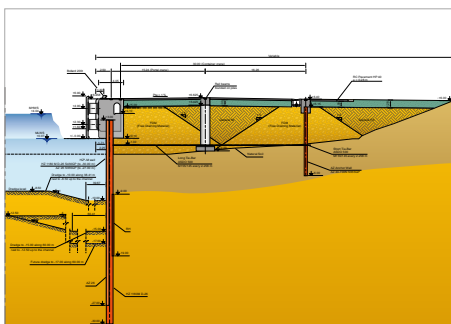
Our services also include coating for corrosion protection and aesthetics, from a selection of systems and colours including galvanisation and multi-layer painting. We can also apply interlock sealants on demand.



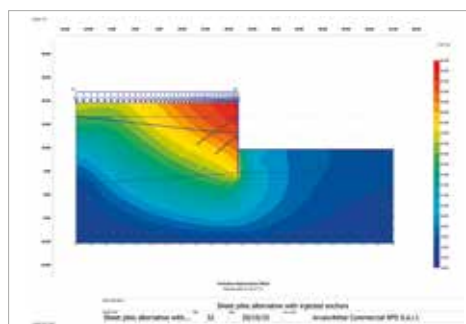
Complete solutions including sheet pile walls, anchors, corner layouts and special piles



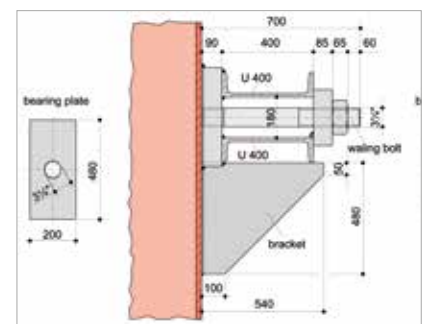
Sheet pile installation drawing



Feasibility studies



Preliminary design



Solutions for execution details





Section	Width		Height		Thickness		Sectional area	Mass		Moment of inertia	Elastic section modulus	Static moment	Plastic section modulus	Class <sup>1)</sup>							
	b	h	t <sub>r</sub>	t <sub>w</sub>	cm <sup>2</sup> /m	single pile		wall	kg/m					kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	S 240 GP	S 270 GP	S 320 GP
	mm	mm	mm	mm	cm <sup>2</sup> /m	kg/m	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 GP	S 500 GP

### AZ<sup>®</sup>-700 and AZ<sup>®</sup>-770

AZ 24-700	700	459	11.2	11.2	174	95.7	137	55820	2430	1435	2867	2	2	2	2	2	2	2	2	3	3
AZ 26-700	700	460	12.2	12.2	187	102.9	147	59720	2600	1535	3070	2	2	2	2	2	2	2	2	2	2
AZ 28-700	700	461	13.2	13.2	200	110.0	157	63620	2760	1635	3273	2	2	2	2	2	2	2	2	2	2
AZ 36-700N	700	499	15.0	11.2	216	118.6	169	89610	3590	2055	4110	2	2	2	2	2	2	2	2	2	2
AZ 38-700N	700	500	16.0	12.2	230	126.4	181	94840	3795	2180	4360	2	2	2	2	2	2	2	2	2	2
AZ 40-700N	700	501	17.0	13.2	244	134.2	192	100080	3995	2305	4605	2	2	2	2	2	2	2	2	2	2
AZ 42-700N	700	499	18.0	14.0	259	142.1	203	104930	4205	2425	4855	2	2	2	2	2	2	2	2	2	2
AZ 44-700N	700	500	19.0	15.0	273	149.9	214	110150	4405	2550	5105	2	2	2	2	2	2	2	2	2	2
AZ 46-700N	700	501	20.0	16.0	287	157.7	225	115370	4605	2675	5350	2	2	2	2	2	2	2	2	2	2
AZ 48-700	700	503	22.0	15.0	288	158.5	226	119650	4755	2745	5490	2	2	2	2	2	2	2	2	2	2
AZ 50-700	700	504	23.0	16.0	303	166.3	238	124890	4955	2870	5735	2	2	2	2	2	2	2	2	2	2
AZ 52-700	700	505	24.0	17.0	317	174.1	249	130140	5155	2990	5985	2	2	2	2	2	2	2	2	2	2

### AZ<sup>®</sup>

AZ 18 <sup>2)</sup>	630	380	9.5	9.5	150	74.4	118	34200	1800	1050	2104	2	2	2	3	3	3	3	3	3
AZ 18-10/10	630	381	10.0	10.0	157	77.8	123	35540	1870	1095	2189	2	2	2	2	3	3	3	3	3
AZ 26 <sup>2)</sup>	630	427	13.0	12.2	198	97.8	155	55510	2600	1530	3059	2	2	2	2	2	2	2	2	2

<sup>1)</sup> Classification according to EN 1993-5. Class 1 is obtained by verification of the rotation capacity for a class-2 cross-section.

<sup>2)</sup> Can be rolled-up or down by 0.5 mm and 1.0 mm on request.

To optimise the design of a steel sheet pile wall according to EN 1993-5, use our free software *Durability* or contact our technical department. Tailor made profiles can be rolled on request.

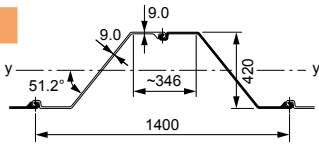
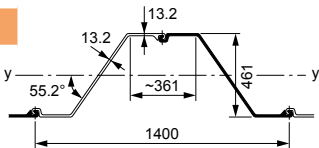
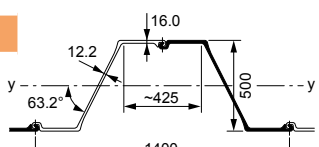
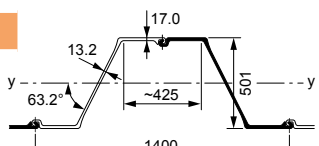


Section	S = Single pile D = Double pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area <sup>1)</sup>		
								cm <sup>2</sup>	kg/m
<b>AZ<sup>®</sup>-800</b>									
<b>AZ 18-800</b>			Per S Per D Per m of wall	102.9 205.7 128.6	<b>80.7</b> <b>161.5</b> <b>100.9</b>	33055 66110 41320	<b>1470</b> <b>2945</b> <b>1840</b>	1793 1793 1793	1.04 2.08 1.30
<b>AZ 20-800</b>			Per S Per D Per m of wall	112.8 225.6 141.0	<b>88.6</b> <b>177.1</b> <b>110.7</b>	36040 72070 45050	<b>1600</b> <b>3205</b> <b>2000</b>	17.87 17.87 17.87	1.04 2.08 1.30
<b>AZ 22-800</b>			Per S Per D Per m of wall	122.8 245.6 153.5	<b>96.4</b> <b>192.8</b> <b>120.5</b>	39035 78070 48790	<b>1730</b> <b>3460</b> <b>2165</b>	17.83 17.83 17.83	1.04 2.08 1.30
<b>AZ 23-800</b>			Per S Per D Per m of wall	120.5 241.0 150.6	<b>94.6</b> <b>189.2</b> <b>118.2</b>	44200 88410 55260	<b>1865</b> <b>3730</b> <b>2330</b>	19.15 19.15 19.15	1.06 2.11 1.32
<b>AZ 25-800</b>			Per S Per D Per m of wall	130.6 261.3 163.3	<b>102.6</b> <b>205.1</b> <b>128.2</b>	47530 95060 59410	<b>2000</b> <b>4005</b> <b>2500</b>	19.07 19.07 19.07	1.06 2.11 1.32
<b>AZ 27-800</b>			Per S Per D Per m of wall	140.8 281.6 176.0	<b>110.5</b> <b>221.0</b> <b>138.1</b>	50860 101720 63570	<b>2135</b> <b>4275</b> <b>2670</b>	19.01 19.01 19.01	1.06 2.11 1.32
<b>AZ<sup>®</sup>-750</b>									
<b>AZ 28-750</b>			Per S Per D Per m of wall	128.4 256.8 171.2	<b>100.8</b> <b>201.6</b> <b>134.4</b>	53650 107310 71540	<b>2110</b> <b>4215</b> <b>2810</b>	20.44 20.44 20.44	1.06 2.11 1.41
<b>AZ 30-750</b>			Per S Per D Per m of wall	138.5 277.1 184.7	<b>108.8</b> <b>217.5</b> <b>145.0</b>	57500 115000 76670	<b>2255</b> <b>4510</b> <b>3005</b>	20.37 20.37 20.37	1.06 2.11 1.41
<b>AZ 32-750</b>			Per S Per D Per m of wall	148.7 297.4 198.3	<b>116.7</b> <b>233.5</b> <b>155.6</b>	61350 122710 81800	<b>2400</b> <b>4805</b> <b>3200</b>	20.31 20.31 20.31	1.06 2.11 1.41

<sup>1)</sup> One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area <sup>1)</sup>		
								cm <sup>2</sup>	kg/m
<b>AZ<sup>®</sup>-700 and AZ<sup>®</sup>-770</b>									
<b>AZ 12-770</b>			Per S	92.5	<b>72.6</b>	16500	<b>960</b>	13.36	0.93
			Per D	185.0	<b>145.2</b>	33000	<b>1920</b>	13.36	1.85
			Per m of wall	120.1	<b>94.3</b>	21430	<b>1245</b>	13.36	1.20
<b>AZ 13-770</b>			Per S	96.9	<b>76.1</b>	17220	<b>1000</b>	13.33	0.93
			Per D	193.8	<b>152.1</b>	34440	<b>2000</b>	13.33	1.85
			Per m of wall	125.8	<b>98.8</b>	22360	<b>1300</b>	13.33	1.20
<b>AZ 14-770</b>			Per S	101.3	<b>79.5</b>	17940	<b>1040</b>	13.31	0.93
			Per D	202.6	<b>159.0</b>	35890	<b>2085</b>	13.31	1.85
			Per m of wall	131.5	<b>103.2</b>	23300	<b>1355</b>	13.31	1.20
<b>AZ 14-770-10/10</b>			Per S	105.6	<b>82.9</b>	18670	<b>1085</b>	13.30	0.93
			Per D	211.2	<b>165.8</b>	37330	<b>2165</b>	13.30	1.85
			Per m of wall	137.2	<b>107.7</b>	24240	<b>1405</b>	13.30	1.20
<b>AZ 12-700</b>									
<b>AZ 12-700</b>			Per S	86.2	<b>67.7</b>	13220	<b>840</b>	12.38	0.86
			Per D	172.5	<b>135.4</b>	26440	<b>1685</b>	12.38	1.71
			Per m of wall	123.2	<b>96.7</b>	18880	<b>1205</b>	12.38	1.22
<b>AZ 13-700</b>			Per S	94.3	<b>74.0</b>	14370	<b>910</b>	12.35	0.86
			Per D	188.5	<b>148.0</b>	28750	<b>1825</b>	12.35	1.71
			Per m of wall	134.7	<b>105.7</b>	20540	<b>1305</b>	12.35	1.22
<b>AZ 13-700-10/10</b>			Per S	98.3	<b>77.2</b>	14960	<b>945</b>	12.33	0.86
			Per D	196.6	<b>154.3</b>	29910	<b>1895</b>	12.33	1.71
			Per m of wall	140.4	<b>110.2</b>	21370	<b>1355</b>	12.33	1.22
<b>AZ 14-700</b>			Per S	102.3	<b>80.3</b>	15530	<b>980</b>	12.32	0.86
			Per D	204.6	<b>160.6</b>	31060	<b>1965</b>	12.32	1.71
			Per m of wall	146.1	<b>114.7</b>	22190	<b>1405</b>	12.32	1.22

<sup>1)</sup> One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area <sup>1)</sup>
		cm <sup>2</sup>	kg/m	cm <sup>4</sup>	cm <sup>3</sup>	cm	m <sup>2</sup> /m
<b>AZ 17-700</b> 	Per S	93.1	<b>73.1</b>	25360	<b>1210</b>	16.50	0.93
	Per D	186.2	<b>146.2</b>	50720	<b>2420</b>	16.50	1.86
	Per m of wall	133.0	<b>104.4</b>	36230	<b>1730</b>	16.50	1.33
<b>AZ 18-700</b> 	Per S	97.5	<b>76.5</b>	26460	<b>1260</b>	16.47	0.93
	Per D	194.9	<b>153.0</b>	52920	<b>2520</b>	16.47	1.86
	Per m of wall	139.2	<b>109.3</b>	37800	<b>1800</b>	16.47	1.33
<b>AZ 19-700</b> 	Per S	101.9	<b>80.0</b>	27560	<b>1310</b>	16.44	0.93
	Per D	203.8	<b>160.0</b>	55130	<b>2620</b>	16.44	1.86
	Per m of wall	145.6	<b>114.3</b>	39380	<b>1870</b>	16.44	1.33
<b>AZ 20-700</b> 	Per S	106.4	<b>83.5</b>	28670	<b>1360</b>	16.42	0.93
	Per D	212.8	<b>167.0</b>	57340	<b>2725</b>	16.42	1.86
	Per m of wall	152.0	<b>119.3</b>	40960	<b>1945</b>	16.42	1.33
<b>AZ 24-700</b> 	Per S	121.9	<b>95.7</b>	39080	<b>1700</b>	17.90	0.97
	Per D	243.8	<b>191.4</b>	78150	<b>3405</b>	17.90	1.93
	Per m of wall	174.1	<b>136.7</b>	55820	<b>2430</b>	17.90	1.38
<b>AZ 26-700</b> 	Per S	131.0	<b>102.9</b>	41800	<b>1815</b>	17.86	0.97
	Per D	262.1	<b>205.7</b>	83610	<b>3635</b>	17.86	1.93
	Per m of wall	187.2	<b>146.9</b>	59720	<b>2600</b>	17.86	1.38
<b>AZ 28-700</b> 	Per S	140.2	<b>110.0</b>	44530	<b>1930</b>	17.83	0.97
	Per D	280.3	<b>220.1</b>	89070	<b>3865</b>	17.83	1.93
	Per m of wall	200.2	<b>157.2</b>	63620	<b>2760</b>	17.83	1.38
<b>AZ 36-700N</b> 	Per S	151.1	<b>118.6</b>	62730	<b>2510</b>	20.37	1.03
	Per D	302.2	<b>237.3</b>	125450	<b>5030</b>	20.37	2.05
	Per m of wall	215.9	<b>169.5</b>	89610	<b>3590</b>	20.37	1.47
<b>AZ 38-700N</b> 	Per S	161.0	<b>126.4</b>	66390	<b>2655</b>	20.31	1.03
	Per D	322.0	<b>252.8</b>	132780	<b>5310</b>	20.31	2.05
	Per m of wall	230.0	<b>180.6</b>	94840	<b>3795</b>	20.31	1.47
<b>AZ 40-700N</b> 	Per S	170.9	<b>134.2</b>	70060	<b>2795</b>	20.25	1.03
	Per D	341.9	<b>268.4</b>	140110	<b>5595</b>	20.25	2.05
	Per m of wall	244.2	<b>191.7</b>	100080	<b>3995</b>	20.25	1.47

<sup>1)</sup> One side, excluding inside of interlocks.

Section

S = Single pile  
D = Double pile

Sectional area

Mass

Moment of inertia

Elastic section modulus

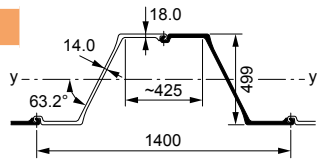
Radius of gyration

Coating area<sup>1)</sup>

cm <sup>2</sup>	kg/m	cm <sup>4</sup>	cm <sup>3</sup>	cm	m <sup>2</sup> /m
-----------------	------	-----------------	-----------------	----	-------------------

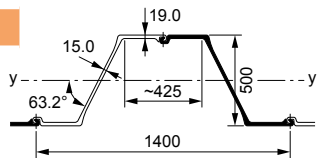
**AZ<sup>®</sup>-700 and AZ<sup>®</sup>-770**

**AZ 42-700N**



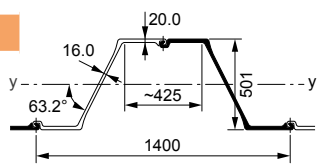
Per S	181.1	<b>142.1</b>	73450	<b>2945</b>	20.14	1.03
Per D	362.1	<b>284.3</b>	146900	<b>5890</b>	20.14	2.06
Per m of wall	258.7	<b>203.1</b>	104930	<b>4205</b>	20.14	1.47

**AZ 44-700N**



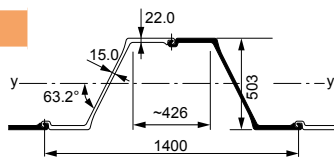
Per S	191.0	<b>149.9</b>	77100	<b>3085</b>	20.09	1.03
Per D	382.0	<b>299.8</b>	154210	<b>6170</b>	20.09	2.06
Per m of wall	272.8	<b>214.2</b>	110150	<b>4405</b>	20.09	1.47

**AZ 46-700N**



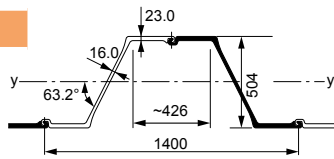
Per S	200.9	<b>157.7</b>	80760	<b>3220</b>	20.05	1.03
Per D	401.8	<b>315.4</b>	161520	<b>6450</b>	20.05	2.06
Per m of wall	287.0	<b>225.3</b>	115370	<b>4605</b>	20.05	1.47

**AZ 48-700**



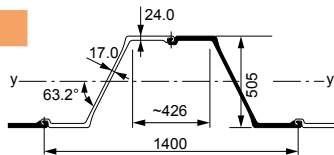
Per S	201.9	<b>158.5</b>	83760	<b>3330</b>	20.37	1.02
Per D	403.8	<b>317.0</b>	167510	<b>6660</b>	20.37	2.04
Per m of wall	288.4	<b>226.4</b>	119650	<b>4755</b>	20.37	1.46

**AZ 50-700**



Per S	211.8	<b>166.3</b>	87430	<b>3470</b>	20.32	1.02
Per D	423.6	<b>332.5</b>	174850	<b>6940</b>	20.32	2.04
Per m of wall	302.6	<b>237.5</b>	124890	<b>4955</b>	20.32	1.46

**AZ 52-700**



Per S	221.7	<b>174.1</b>	91100	<b>3610</b>	20.27	1.02
Per D	443.5	<b>348.1</b>	182200	<b>7215</b>	20.27	2.04
Per m of wall	316.8	<b>248.7</b>	130140	<b>5155</b>	20.27	1.46

<sup>1)</sup> One side, excluding inside of interlocks.



Section	S = Single pile D = Double pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area <sup>1)</sup>		
		cm <sup>2</sup>	kg/m	cm <sup>4</sup>	cm <sup>3</sup>	cm	m <sup>2</sup> /m		
<b>AZ<sup>®</sup></b>									
<b>AZ 18</b>			Per S	94.8	<b>74.4</b>	21540	<b>1135</b>	15.07	0.86
			Per D	189.6	<b>148.8</b>	43080	<b>2270</b>	15.07	1.71
			Per m of wall	150.4	<b>118.1</b>	34200	<b>1800</b>	15.07	1.35
<b>AZ 18-10/10</b>			Per S	99.1	<b>77.8</b>	22390	<b>1175</b>	15.04	0.86
			Per D	198.1	<b>155.5</b>	44790	<b>2355</b>	15.04	1.71
			Per m of wall	157.2	<b>123.4</b>	35540	<b>1870</b>	15.04	1.35
<b>AZ 26</b>			Per S	124.6	<b>97.8</b>	34970	<b>1640</b>	16.75	0.90
			Per D	249.2	<b>195.6</b>	69940	<b>3280</b>	16.75	1.78
			Per m of wall	197.8	<b>155.2</b>	55510	<b>2600</b>	16.75	1.41

<sup>1)</sup> One side, excluding inside of interlocks.



Boardwalk, Aarschot, Belgium

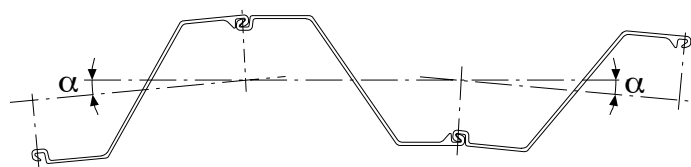
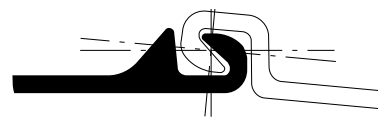
## Interlock



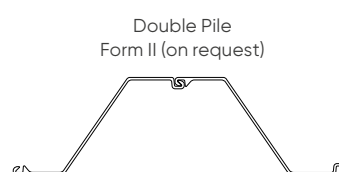
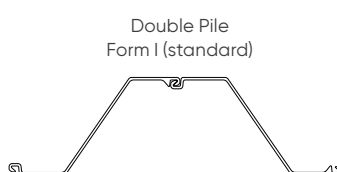
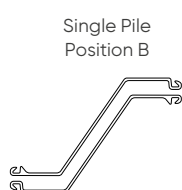
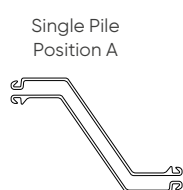
AZ® Larssen interlock in accordance with EN 10248.

All available AZ sheet piles can be interlocked, as well as the AU, PU and GU (except GU-400).

Theoretical interlock swing:  $\alpha_{\max} = 5^\circ$

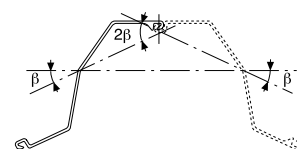
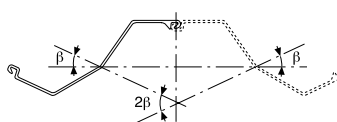


## Delivery form



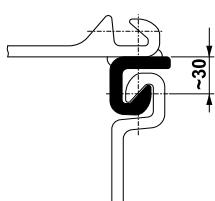
## Bent piles

Maximum bending angle:  $\beta = 25^\circ$ . Z-piles are usually bent in the middle of the web. They are generally delivered as single piles. Double piles are available upon request.

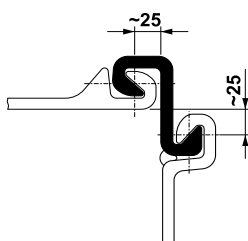


## Corner sections

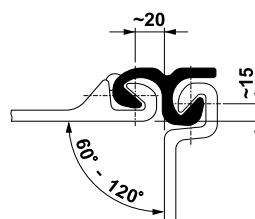
C 9  
Mass ~ 9.3 kg/m  
Coating area 0.15 m<sup>2</sup>/m



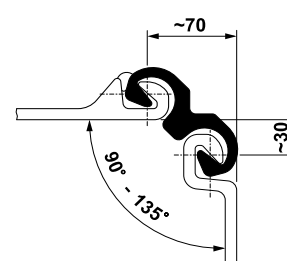
C 14  
Mass ~ 14.4 kg/m  
Coating area 0.22 m<sup>2</sup>/m



DELTA 13  
Mass ~ 13.1 kg/m  
Coating area 0.19 m<sup>2</sup>/m



OMEGA 18  
Mass ~ 18.0 kg/m  
Coating area 0.24 m<sup>2</sup>/m

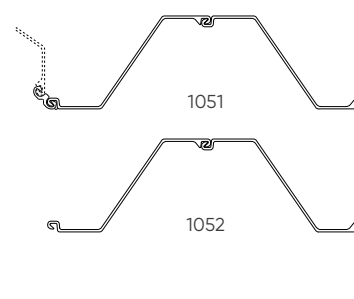
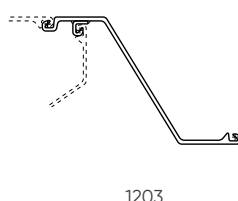
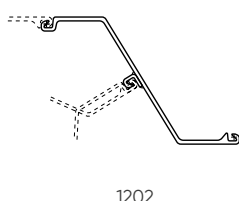
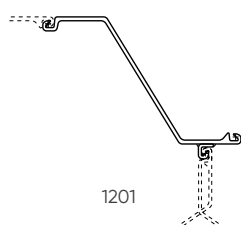


Special corner sections interlocking with U and Z-sections make it possible to form corner or junction piles without using fabricated special piles. Corner sections are fixed to the sheet pile in accordance with EN 12063.

Different welding specifications are available on request. The corner sections are threaded and welded with usually a 200 mm setback from the top of the piles.

## Corner and junction piles

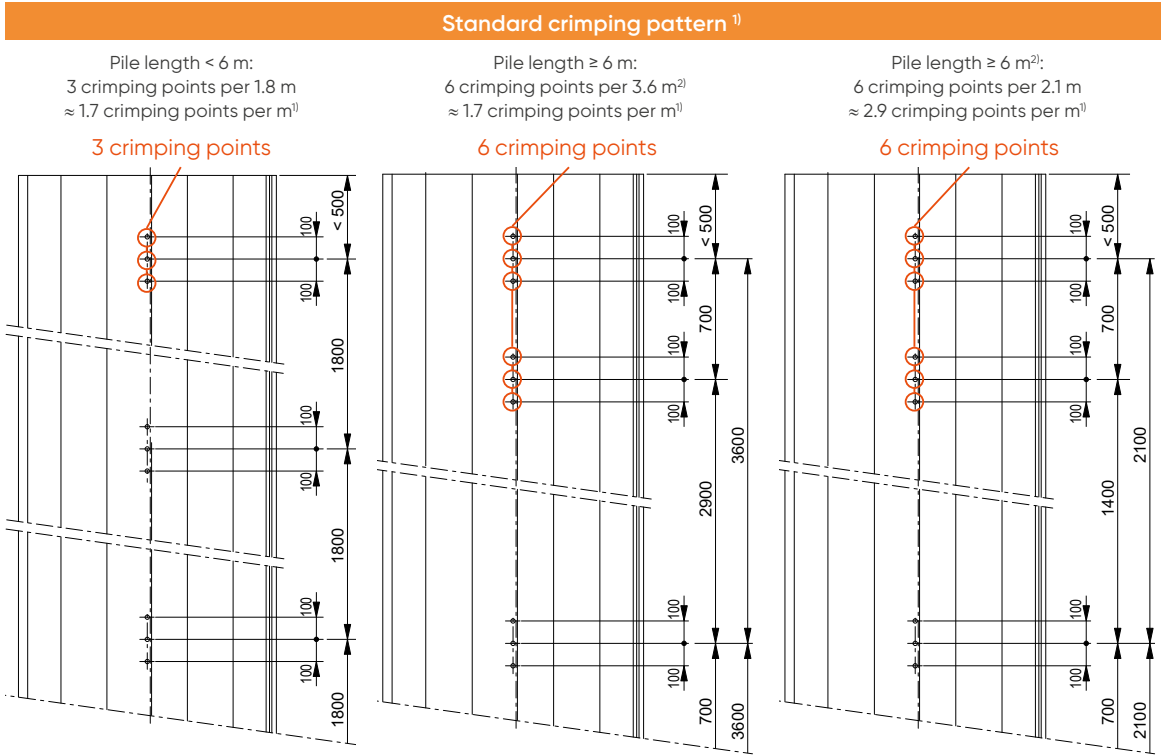
The following special piles, among others, are available as single and double piles on request.



## Crimping

Threaded AZ® double piles are recommended for facilitating the installation process. Although crimping of AZ double piles is not required

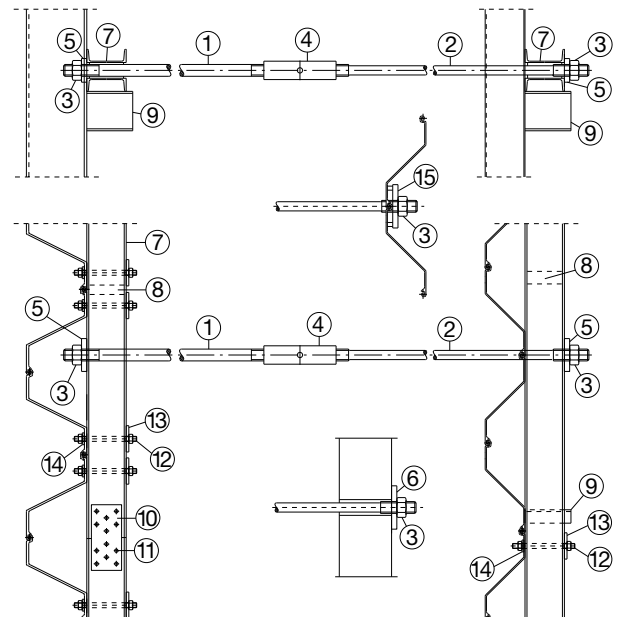
for structural design reasons, most customers request crimping according to our standard specification for handling and driving.



<sup>1)</sup> Amount and layout of crimping points may differ at both ends. Special crimping on request.  
<sup>2)</sup> For the profiles AZ 38-700N, AZ 44-700N and AZ 50-700 as well as their derivatives.

## Tie back system

Most sheet pile retaining walls need supplementary support at the top, in addition to embedment in the soil. Temporary cofferdams generally use waler and strut bracing inside the excavation. Permanent or large retaining walls are often tied back to an anchor wall installed at a certain distance behind the main wall. Other anchor systems, like injection anchors or anchor piles are also common practice. The drawing shows a typical horizontal tie-rod connection for sheet pile walls.



The following components can be seen:

- |                     |                             |                  |
|---------------------|-----------------------------|------------------|
| ① Plain tie-rod     | ⑥ Bearing plate on concrete | ⑩ Splicing plate |
| ② Upset end tie-rod | ⑦ Waling                    | ⑪ Splicing bolt  |
| ③ Nut               | ⑧ Spacer                    | ⑫ Fixing bolt    |
| ④ Turnbuckle        | ⑨ Supporting bracket        | ⑬                |
| ⑤ Bearing plate     |                             | ⑭ Fixing plate   |
|                     |                             | ⑮                |



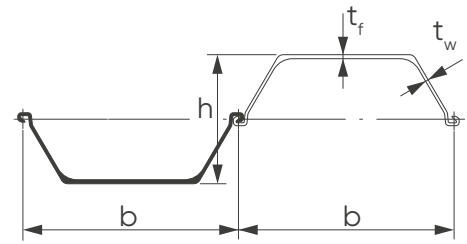




# U-Sections

The advantages of U-sections include:

- a wide range of sections forming several series with various geometrical characteristics, allowing a technically and economically optimal choice for each specific project;
- the combination of great profile depth with large flange thickness giving excellent mechanical properties;
- the symmetrical form of the single element has made these sheet piles particularly convenient for re-use;
- the possibility of assembling and crimping the piles into pairs at the mill improves installation quality and performance;
- easy fixing of tie-rods and swivelling attachments, even under water;
- great corrosion resistance, with the steel section being thickest at the critical corrosion points.



Section	Width		Height		Thickness		Sectional area	Mass		Moment of inertia	Elastic section modulus	Static moment	Plastic section modulus	Class <sup>1)</sup>									
	b	h	t <sub>f</sub>	t <sub>w</sub>	cm <sup>2</sup> /m	single pile		wall	kg/m					kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP
	mm	mm	mm	mm	cm <sup>2</sup> /m	kg/m	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 GP	S 500 GP			

## AU™ sections

AU 14	750	408	10.0	8.3	132	77.9	<b>104</b>	28680	<b>1405</b>	820	1663	2	2	3	3	3	3	3	3	3	3
AU 16	750	411	11.5	9.3	147	86.3	<b>115</b>	32850	<b>1600</b>	935	1891	2	2	2	2	2	2	3	3	3	3
AU 18	750	441	10.5	9.1	150	88.5	<b>118</b>	39300	<b>1780</b>	1030	2082	2	3	3	3	3	3	3	3	3	4
AU 20	750	444	12.0	10.0	165	96.9	<b>129</b>	44440	<b>2000</b>	1155	2339	2	2	2	3	3	3	3	3	3	3
AU 23	750	447	13.0	9.5	173	102.1	<b>136</b>	50700	<b>2270</b>	1285	2600	2	2	2	3	3	3	3	3	3	3
AU 25	750	450	14.5	10.2	188	110.4	<b>147</b>	56240	<b>2500</b>	1420	2866	2	2	2	2	2	2	3	3	3	3

## PU® sections

PU 12	600	360	9.8	9.0	140	66.1	<b>110</b>	21600	<b>1200</b>	715	1457	-	-	-	2	2	2	3	3	3
PU 12S	600	360	10.0	10.0	151	71.0	<b>118</b>	22660	<b>1260</b>	755	1543	-	-	-	2	2	2	2	3	3
PU 18 <sup>-1</sup>	600	430	10.2	8.4	154	72.6	<b>121</b>	35950	<b>1670</b>	980	1988	2	2	2	2	2	3	3	3	3
PU 18	600	430	11.2	9.0	163	76.9	<b>128</b>	38650	<b>1800</b>	1055	2134	2	2	2	2	2	2	2	2	3
PU 18 <sup>-1</sup>	600	430	12.2	9.5	172	81.1	<b>135</b>	41320	<b>1920</b>	1125	2280	2	2	2	2	2	2	2	2	2
PU 22 <sup>-1</sup>	600	450	11.1	9.0	174	81.9	<b>137</b>	46380	<b>2060</b>	1195	2422	2	2	2	2	2	3	3	3	3
PU 22	600	450	12.1	9.5	183	86.1	<b>144</b>	49460	<b>2200</b>	1275	2580	2	2	2	2	2	2	2	3	3
PU 22 <sup>-1</sup>	600	450	13.1	10.0	192	90.4	<b>151</b>	52510	<b>2335</b>	1355	2735	2	2	2	2	2	2	2	2	2
PU 28 <sup>-1</sup>	600	452	14.2	9.7	207	97.4	<b>162</b>	60580	<b>2680</b>	1525	3087	2	2	2	2	2	2	2	2	2
PU 28	600	454	15.2	10.1	216	101.8	<b>170</b>	64460	<b>2840</b>	1620	3269	2	2	2	2	2	2	2	2	2
PU 28 <sup>-1</sup>	600	456	16.2	10.5	226	106.2	<b>177</b>	68380	<b>3000</b>	1710	3450	2	2	2	2	2	2	2	2	2
PU 32 <sup>-1</sup>	600	452	18.5	10.6	233	109.9	<b>183</b>	69210	<b>3065</b>	1745	3525	2	2	2	2	2	2	2	2	2
PU 32	600	452	19.5	11.0	242	114.1	<b>190</b>	72320	<b>3200</b>	1825	3687	2	2	2	2	2	2	2	2	2
PU 32 <sup>-1</sup>	600	452	20.5	11.4	251	118.4	<b>197</b>	75410	<b>3340</b>	1905	3845	2	2	2	2	2	2	2	2	2

## GU® sections

GU 6N	600	309	6.0	6.0	89	41.9	<b>70</b>	9670	<b>625</b>	375	765	3	3	3	4	4	4	4	4	-
GU 7N	600	310	6.5	6.4	94	44.1	<b>74</b>	10450	<b>675</b>	400	825	3	3	3	3	3	4	4	4	-
GU 7S	600	311	7.2	6.9	98	46.3	<b>77</b>	11540	<b>740</b>	440	900	2	2	3	3	3	3	3	3	-
GU 7HWS	600	312	7.3	6.9	101	47.4	<b>79</b>	11620	<b>745</b>	445	910	2	2	3	3	3	3	3	3	-
GU 8N	600	312	7.5	7.1	103	48.5	<b>81</b>	12010	<b>770</b>	460	935	2	2	3	3	3	3	3	3	-
GU 8S	600	313	8.0	7.5	108	50.8	<b>85</b>	12800	<b>820</b>	490	995	2	2	2	3	3	3	3	3	-

Section	Width		Height		Thickness		Sectional area	Mass		Moment of inertia	Elastic section modulus	Static moment	Plastic section modulus	Class <sup>1)</sup>							
	b	h	t <sub>f</sub>	t <sub>w</sub>	cm <sup>2</sup> /m	single pile		wall	cm <sup>4</sup> /m					cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP
	mm	mm	mm	mm	cm <sup>2</sup> /m	kg/m	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 GP	S 500 GP		
<b>GU<sup>®</sup> sections</b>																					
GU 10N	600	316	9.0	6.8	118	55.8	<b>93</b>	15700	<b>995</b>	565	1160	2	2	3	3	3	3	3	3	-	
GU 11N	600	318	10.0	7.4	128	60.2	<b>100</b>	17450	<b>1095</b>	630	1280	2	2	2	2	3	3	3	3	-	
GU 12N	600	320	11.0	8.0	137	64.6	<b>108</b>	19220	<b>1200</b>	690	1400	2	2	2	2	2	2	3	3	-	
GU 13N	600	418	9.0	7.4	127	59.9	<b>100</b>	26590	<b>1270</b>	755	1535	2	2	2	2	2	3	3	3	-	
GU 14N	600	420	10.0	8.0	136	64.3	<b>107</b>	29410	<b>1400</b>	830	1685	2	2	2	2	2	2	2	2	-	
GU 15N	600	422	11.0	8.6	146	68.7	<b>115</b>	32260	<b>1530</b>	910	1840	2	2	2	2	2	2	2	2	-	
GU 16N	600	430	10.2	8.4	154	72.6	<b>121</b>	35950	<b>1670</b>	980	1988	2	2	2	2	2	3	3	3	-	
GU 18N	600	430	11.2	9.0	163	76.9	<b>128</b>	38650	<b>1800</b>	1055	2134	2	2	2	2	2	2	2	2	-	
GU 20N	600	430	12.2	9.5	172	81.1	<b>135</b>	41320	<b>1920</b>	1125	2280	2	2	2	2	2	2	2	2	-	
GU 21N	600	450	11.1	9.0	174	81.9	<b>137</b>	46380	<b>2060</b>	1195	2422	2	2	2	2	2	3	3	3	-	
GU 22N	600	450	12.1	9.5	183	86.1	<b>144</b>	49460	<b>2200</b>	1275	2580	2	2	2	2	2	2	2	2	-	
GU 23N	600	450	13.1	10.0	192	90.4	<b>151</b>	52510	<b>2335</b>	1355	2735	2	2	2	2	2	2	2	2	-	
GU 27N	600	452	14.2	9.7	207	97.4	<b>162</b>	60580	<b>2680</b>	1525	3087	2	2	2	2	2	2	2	2	-	
GU 28N	600	454	15.2	10.1	216	101.8	<b>170</b>	64460	<b>2840</b>	1620	3269	2	2	2	2	2	2	2	2	-	
GU 30N	600	456	16.2	10.5	226	106.2	<b>177</b>	68380	<b>3000</b>	1710	3450	2	2	2	2	2	2	2	2	-	
GU 31N	600	452	18.5	10.6	233	109.9	<b>183</b>	69210	<b>3065</b>	1745	3525	2	2	2	2	2	2	2	2	-	
GU 32N	600	452	19.5	11.0	242	114.1	<b>190</b>	72320	<b>3200</b>	1825	3687	2	2	2	2	2	2	2	2	-	
GU 33N	600	452	20.5	11.4	251	118.4	<b>197</b>	75410	<b>3340</b>	1905	3845	2	2	2	2	2	2	2	2	-	
GU 16-400	400	290	12.7	9.4	197	62.0	<b>155</b>	22580	<b>1560</b>	885	1815	2	2	2	2	2	2	2	-	-	
GU 18-400	400	292	15.0	9.7	221	69.3	<b>173</b>	26090	<b>1785</b>	1015	2080	2	2	2	2	2	2	2	-	-	

The moment of inertia and section moduli values given assume correct shear transfer across the interlock.

<sup>1)</sup> Classification according to EN 1993-5. Class 1 is obtained by verification of the rotation capacity for a class 2 cross-section.

To optimise the design of a steel sheet pile wall according to EN 1993-5, use our free software *Durability* or contact our technical department.

Tailor made profiles can be rolled on request.

## Characteristics – AU™ sections

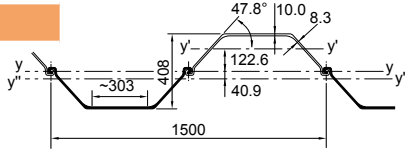
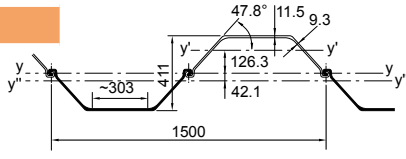
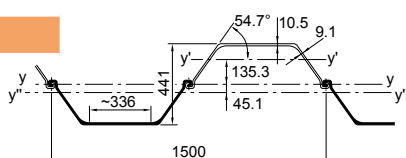
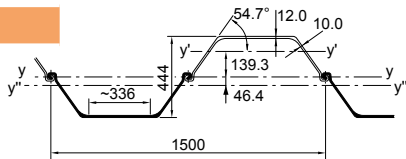
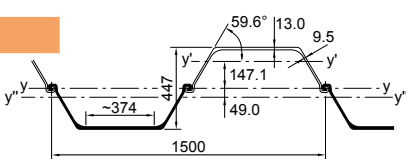
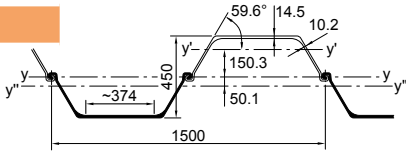
A weight reduction of about 10% compared to the 600 mm PU series has been achieved by optimising the geometric dimensions. The increased width **allows faster installation**, reduces the amount of coating required, due to the smaller perimeter, and increases watertightness thanks to fewer interlocks per metre of wall. Despite their greater width, the driving energy required for AU piles is not higher, thanks to their smooth and open shape and the patented radii at the web/flange connection.

## Characteristics – PU<sup>®</sup> sections

PU sections are 600 mm wide U-piles manufactured in Belval. The shapes of the **PU 18**, **PU 22** and **PU 28** have been engineered with "reinforced shoulders" yielding the optimum section geometry **for hard driving conditions** as well as **multiple re-use**. Re-using steel sheet piles drastically improves the environmental impact of a steel solution.

## Characteristics – GU<sup>®</sup> sections

ArcelorMittal's rolling mill in Dabrowa, Poland, produces hot rolled U-shaped steel sheet piles. The rolling mill has extended their portfolio during the last years with following sections: GU 7N, GU 14N, GU 18N, GU 22N, GU 28N, GU 32N and, in 2017, the GU 11N range.

Section	S = Single pile D = Double pile T = Triple pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area <sup>1)</sup>	
		cm <sup>2</sup>	kg/m	cm <sup>4</sup>	cm <sup>3</sup>	cm	m <sup>2</sup> /m	
<b>AU™ sections</b>								
<b>AU 14</b>		Per S	99.2	<b>77.9</b>	6590	<b>457</b>	8.15	0.96
		Per D	198.5	<b>155.8</b>	43020	<b>2110</b>	14.73	1.91
		Per T	297.7	<b>233.7</b>	59550	<b>2435</b>	14.15	2.86
		Per m of wall	132.3	<b>103.8</b>	28680	<b>1405</b>	14.73	1.27
<b>AU 16</b>		Per S	109.9	<b>86.3</b>	7110	<b>481</b>	8.04	0.96
		Per D	219.7	<b>172.5</b>	49280	<b>2400</b>	14.98	1.91
		Per T	329.6	<b>258.7</b>	68080	<b>2750</b>	14.37	2.86
		Per m of wall	146.5	<b>115.0</b>	32850	<b>1600</b>	14.98	1.27
<b>AU 18</b>		Per S	112.7	<b>88.5</b>	8760	<b>554</b>	8.82	1.01
		Per D	225.5	<b>177.0</b>	58950	<b>2670</b>	16.17	2.00
		Per T	338.2	<b>265.5</b>	81520	<b>3065</b>	15.53	2.99
		Per m of wall	150.3	<b>118.0</b>	39300	<b>1780</b>	16.17	1.33
<b>AU 20</b>		Per S	123.4	<b>96.9</b>	9380	<b>579</b>	8.72	1.01
		Per D	246.9	<b>193.8</b>	66660	<b>3000</b>	16.43	2.00
		Per T	370.3	<b>290.7</b>	92010	<b>3425</b>	15.76	2.99
		Per m of wall	164.6	<b>129.2</b>	44440	<b>2000</b>	16.43	1.33
<b>AU 23</b>		Per S	130.1	<b>102.1</b>	9830	<b>579</b>	8.69	1.03
		Per D	260.1	<b>204.2</b>	76050	<b>3405</b>	17.10	2.04
		Per T	390.2	<b>306.3</b>	104680	<b>3840</b>	16.38	3.05
		Per m of wall	173.4	<b>136.1</b>	50700	<b>2270</b>	17.10	1.36
<b>AU 25</b>		Per S	140.6	<b>110.4</b>	10390	<b>601</b>	8.60	1.03
		Per D	281.3	<b>220.8</b>	84370	<b>3750</b>	17.32	2.04
		Per T	422.0	<b>331.3</b>	115950	<b>4215</b>	16.58	3.05
		Per m of wall	187.5	<b>147.2</b>	56240	<b>2500</b>	17.32	1.36

<sup>1)</sup> One side, excluding inside of interlocks.



Section	S = Single pile D = Double pile T = Triple pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area <sup>1)</sup>	
		cm <sup>2</sup>	kg/m	cm <sup>4</sup>	cm <sup>3</sup>	cm	m <sup>2</sup> /m	
<b>PU<sup>®</sup> sections</b>								
<b>PU 28<sup>-1</sup></b>		Per S	124.1	<b>97.4</b>	9740	<b>576</b>	8.86	0.93
		Per D	248.2	<b>194.8</b>	72700	<b>3215</b>	17.12	1.85
		Per T	372.3	<b>292.2</b>	100170	<b>3645</b>	16.40	2.77
		Per m of wall	206.8	<b>162.3</b>	60580	<b>2680</b>	17.12	1.54
<b>PU 28</b>		Per S	129.7	<b>101.8</b>	10070	<b>589</b>	8.81	0.93
		Per D	259.4	<b>203.6</b>	77350	<b>3405</b>	17.27	1.85
		Per T	389.0	<b>305.4</b>	106490	<b>3850</b>	16.55	2.77
		Per m of wall	216.1	<b>169.6</b>	64460	<b>2840</b>	17.27	1.54
<b>PU 28<sup>-1</sup></b>		Per S	135.3	<b>106.2</b>	10400	<b>600</b>	8.77	0.93
		Per D	270.7	<b>212.5</b>	82060	<b>3600</b>	17.41	1.85
		Per T	406.0	<b>318.7</b>	112870	<b>4060</b>	16.67	2.77
		Per m of wall	225.6	<b>177.1</b>	68380	<b>3000</b>	17.41	1.54
<b>PU 32<sup>-1</sup></b>		Per S	140.0	<b>109.9</b>	10740	<b>625</b>	8.76	0.92
		Per D	280.0	<b>219.8</b>	83050	<b>3675</b>	17.22	1.83
		Per T	420.0	<b>329.7</b>	114310	<b>4150</b>	16.50	2.74
		Per m of wall	233.3	<b>183.2</b>	69210	<b>3065</b>	17.22	1.52
<b>PU 32</b>		Per S	145.4	<b>114.1</b>	10950	<b>633</b>	8.68	0.92
		Per D	290.8	<b>228.3</b>	86790	<b>3840</b>	17.28	1.83
		Per T	436.2	<b>342.4</b>	119370	<b>4330</b>	16.54	2.74
		Per m of wall	242.3	<b>190.2</b>	72320	<b>3200</b>	17.28	1.52
<b>PU 32<sup>-1</sup></b>		Per S	150.8	<b>118.4</b>	11150	<b>640</b>	8.60	0.92
		Per D	301.6	<b>236.8</b>	90490	<b>4005</b>	17.32	1.83
		Per T	452.4	<b>355.2</b>	124370	<b>4505</b>	16.58	2.74
		Per m of wall	251.3	<b>197.3</b>	75410	<b>3340</b>	17.32	1.52

<sup>1)</sup> One side, excluding inside of interlocks.



Section	S = Single pile D = Double pile T = Triple pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area <sup>1)</sup>
<b>GU<sup>®</sup> sections</b>							
<b>GU 6N</b>	Per S	53.4	<b>41.9</b>	2160	<b>215</b>	6.36	0.76
	Per D	106.8	<b>83.8</b>	11610	<b>750</b>	10.43	1.51
	Per T	160.2	<b>125.7</b>	16200	<b>890</b>	10.06	2.26
	Per m of wall	89.0	<b>69.9</b>	9670	<b>625</b>	10.43	1.26
<b>GU 7N</b>	Per S	56.2	<b>44.1</b>	2250	<b>220</b>	6.33	0.76
	Per D	112.4	<b>88.2</b>	12540	<b>810</b>	10.56	1.51
	Per T	168.6	<b>132.4</b>	17470	<b>955</b>	10.18	2.26
	Per m of wall	93.7	<b>73.5</b>	10450	<b>675</b>	10.56	1.26
<b>GU 7S</b>	Per S	58.9	<b>46.3</b>	2370	<b>225</b>	6.35	0.76
	Per D	117.9	<b>92.5</b>	13850	<b>890</b>	10.84	1.51
	Per T	176.8	<b>138.8</b>	19260	<b>1045</b>	10.44	2.26
	Per m of wall	98.2	<b>77.1</b>	11540	<b>740</b>	10.84	1.26
<b>GU 7HWS</b>	Per S	60.4	<b>47.4</b>	2380	<b>225</b>	6.28	0.76
	Per D	120.9	<b>94.9</b>	13940	<b>895</b>	10.74	1.51
	Per T	181.3	<b>142.3</b>	19390	<b>1050</b>	10.34	2.26
	Per m of wall	100.7	<b>79.1</b>	11620	<b>745</b>	10.74	1.26
<b>GU 8N</b>	Per S	61.8	<b>48.5</b>	2420	<b>225</b>	6.26	0.76
	Per D	123.7	<b>97.1</b>	14420	<b>925</b>	10.80	1.51
	Per T	185.5	<b>145.6</b>	20030	<b>1080</b>	10.39	2.26
	Per m of wall	103.1	<b>80.9</b>	12010	<b>770</b>	10.80	1.26
<b>GU 8S</b>	Per S	64.7	<b>50.8</b>	2510	<b>230</b>	6.23	0.76
	Per D	129.3	<b>101.5</b>	15360	<b>980</b>	10.90	1.51
	Per T	194.0	<b>152.3</b>	21320	<b>1145</b>	10.48	2.26
	Per m of wall	107.8	<b>84.6</b>	12800	<b>820</b>	10.90	1.26
<b>GU 10N</b>	Per S	71.1	<b>55.8</b>	3100	<b>270</b>	6.60	0.78
	Per D	142.2	<b>111.6</b>	18840	<b>1190</b>	11.51	1.55
	Per T	213.3	<b>167.4</b>	26150	<b>1380</b>	11.07	2.32
	Per m of wall	118.5	<b>93.0</b>	15700	<b>995</b>	11.51	1.29
<b>GU 11N</b>	Per S	76.7	<b>60.2</b>	3280	<b>280</b>	6.53	0.78
	Per D	153.4	<b>120.4</b>	20930	<b>1315</b>	11.68	1.55
	Per T	230.1	<b>180.7</b>	29010	<b>1515</b>	11.23	2.32
	Per m of wall	127.9	<b>100.4</b>	17450	<b>1095</b>	11.68	1.29
<b>GU 12N</b>	Per S	82.3	<b>64.6</b>	3450	<b>290</b>	6.47	0.78
	Per D	164.7	<b>129.3</b>	23060	<b>1440</b>	11.83	1.55
	Per T	247.0	<b>193.9</b>	31890	<b>1650</b>	11.36	2.32
	Per m of wall	137.2	<b>107.7</b>	19220	<b>1200</b>	11.83	1.29

<sup>1)</sup> One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile T = Triple pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area <sup>1)</sup>
	Per S	76.3	<b>59.9</b>	5440	<b>395</b>	8.44	0.85
	Per D	152.6	<b>119.8</b>	31900	<b>1525</b>	14.46	1.69
	Per T	228.9	<b>179.7</b>	44350	<b>1785</b>	13.92	2.53
	Per m of wall	127.2	<b>99.8</b>	26590	<b>1270</b>	14.46	1.41
		Per S	81.9	<b>64.3</b>	5750	<b>410</b>	8.38
Per D		163.8	<b>128.6</b>	35290	<b>1680</b>	14.68	1.69
Per T		245.6	<b>192.8</b>	48970	<b>1955</b>	14.12	2.53
Per m of wall		136.5	<b>107.1</b>	29410	<b>1400</b>	14.68	1.41
		Per S	87.5	<b>68.7</b>	6070	<b>425</b>	8.33
	Per D	175.1	<b>137.4</b>	38710	<b>1835</b>	14.87	1.69
	Per T	262.6	<b>206.2</b>	53640	<b>2130</b>	14.29	2.53
	Per m of wall	145.9	<b>114.5</b>	32260	<b>1530</b>	14.87	1.41
		Per S	92.5	<b>72.6</b>	6960	<b>475</b>	8.67
Per D		185.0	<b>145.2</b>	43140	<b>2005</b>	15.30	1.72
Per T		277.5	<b>217.8</b>	59840	<b>2330</b>	14.69	2.58
Per m of wall		154.2	<b>121.0</b>	35950	<b>1670</b>	15.30	1.43
		Per S	98.0	<b>76.9</b>	7220	<b>485</b>	8.58
	Per D	196.0	<b>153.8</b>	46380	<b>2160</b>	15.38	1.72
	Per T	294.0	<b>230.7</b>	64240	<b>2495</b>	14.78	2.58
	Per m of wall	163.3	<b>128.2</b>	38650	<b>1800</b>	15.38	1.43
		Per S	103.4	<b>81.1</b>	7480	<b>495</b>	8.51
Per D		206.8	<b>162.3</b>	49580	<b>2305</b>	15.49	1.72
Per T		310.2	<b>243.5</b>	68600	<b>2655</b>	14.87	2.58
Per m of wall		172.3	<b>135.2</b>	41320	<b>1920</b>	15.49	1.43
		Per S	104.3	<b>81.9</b>	8460	<b>535</b>	9.01
	Per D	208.7	<b>163.8</b>	55650	<b>2475</b>	16.33	1.79
	Per T	313.0	<b>245.7</b>	77020	<b>2850</b>	15.69	2.68
	Per m of wall	173.9	<b>136.5</b>	46380	<b>2060</b>	16.33	1.49
		Per S	109.7	<b>86.1</b>	8740	<b>546</b>	8.93
Per D		219.5	<b>172.3</b>	59360	<b>2640</b>	16.45	1.79
Per T		329.2	<b>258.4</b>	82060	<b>3025</b>	15.79	2.68
Per m of wall		182.9	<b>143.6</b>	49460	<b>2200</b>	16.45	1.49
		Per S	115.2	<b>90.4</b>	9020	<b>555</b>	8.85
	Per D	230.4	<b>180.9</b>	63010	<b>2800</b>	16.54	1.79
	Per T	345.6	<b>271.3</b>	87020	<b>3205</b>	15.87	2.68
	Per m of wall	192.0	<b>150.7</b>	52510	<b>2335</b>	16.54	1.49

<sup>1)</sup> One side, excluding inside of interlocks.

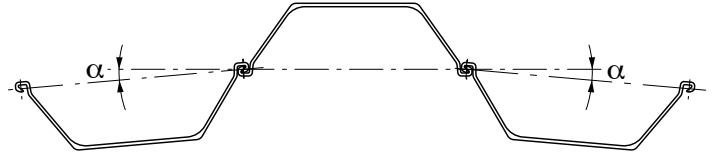




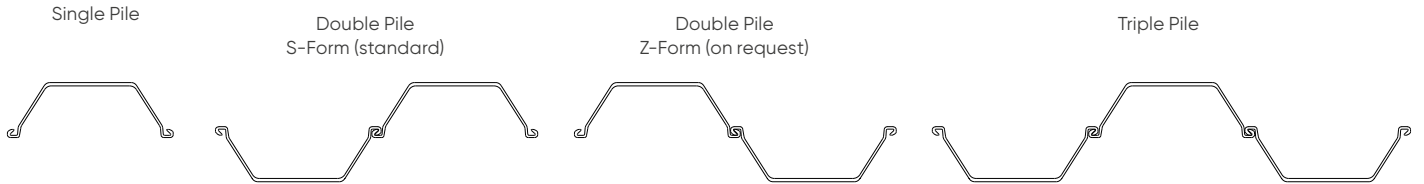
## Interlock

All AU™, PU® and GU® sheet piles feature Larssen interlocks in accordance with EN 10248. AU, PU and GU (except GU-400), as well as the AZ series, can be interlocked.

Theoretical interlock swing:  $\alpha_{\max} = 5^\circ$

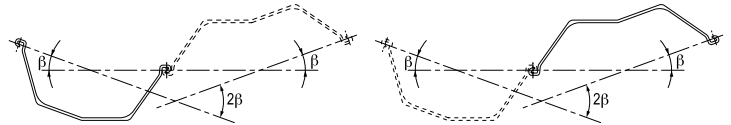


## Delivery form



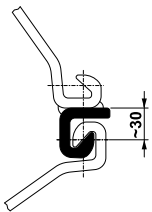
## Bent piles

Maximum bending angle:  $\beta = 25^\circ$ . U-piles are bent in the middle of the flange. They are generally delivered as single piles. Double piles are available upon request.

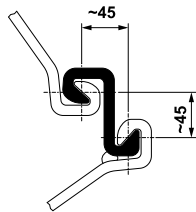


## Corner sections

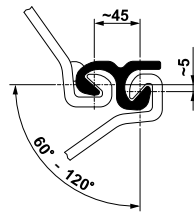
**C 9**  
Mass ~ 9.3 kg/m  
Coating area 0.15 m<sup>2</sup>/m



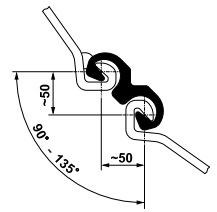
**C 14**  
Mass ~ 14.4 kg/m  
Coating area 0.22 m<sup>2</sup>/m



**DELTA 13**  
Mass ~ 13.1 kg/m  
Coating area 0.19 m<sup>2</sup>/m



**OMEGA 18**  
Mass ~ 18.0 kg/m  
Coating area 0.24 m<sup>2</sup>/m

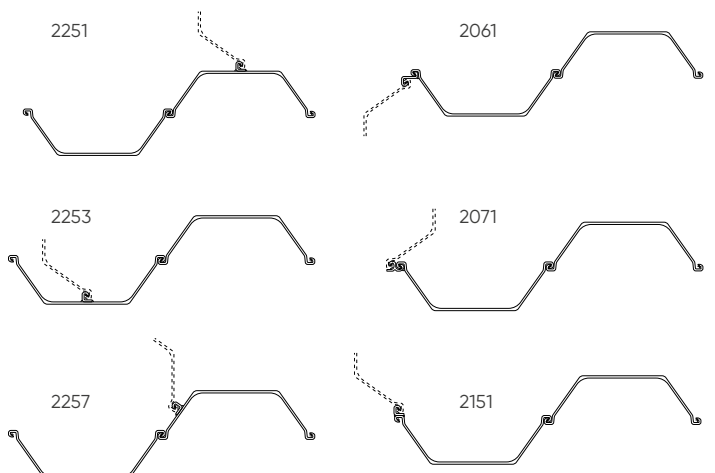
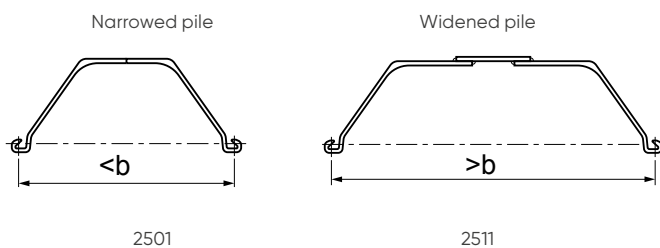


Special corner sections interlocking with U- and Z-sections make it possible to form corner or junction piles without using fabricated special piles. Corner sections are fixed to the sheet pile in accordance with EN 12063.

Different welding specifications are available on request. The corner sections are threaded and welded with usually a 200 mm setback from the top of the piles.

## Fabricated piles, corner and junction piles

On request, arrangements can be made for widened or narrowed fabricated piles. The following special piles, among others, are available on request as single and double piles.



## Crimping

Contrary to Z-piles, the interlocks of U-piles have to transmit shear forces. To guarantee proper shear force transmission, ArcelorMittal's U-sections can be delivered as double piles with crimped interlocks.

See sketch for ArcelorMittal's standard crimping pattern. The allowable shear force per crimping point depends on the section and steel grade. **A characteristic resistance  $R_k$  per crimp of minimum 75 kN at a displacement of up to 10 mm can be achieved<sup>2)</sup>.**

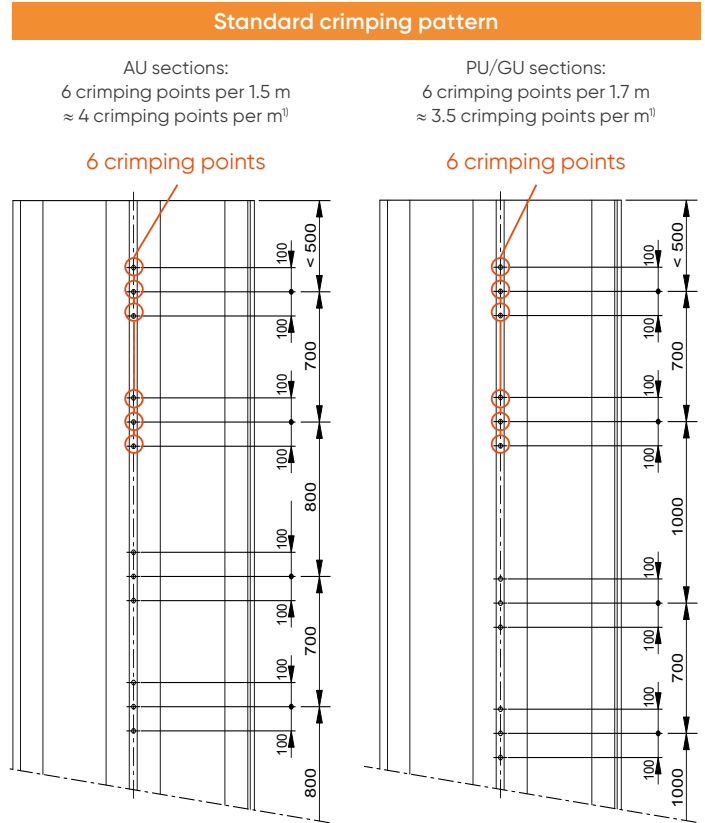
The theoretical section properties of a continuous wall may have to be reduced even for double piles crimped<sup>3)</sup>.



<sup>1)</sup> Amount and layout of crimping points may differ at both ends. Special crimping on request.

<sup>2)</sup> The value of  $R_k$  depends predominantly on the profile and steel grade. Please contact our technical department for more information. See also EN 10248-1:2023 for the testing procedure and for additional stiffness requirement of the crimping points.

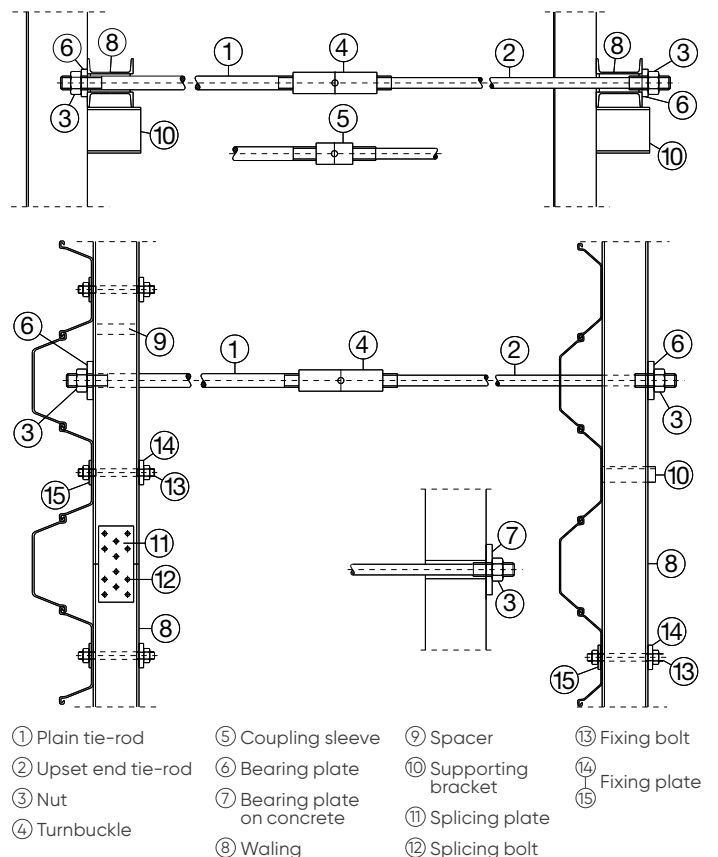
<sup>3)</sup> Based on EN 1993-5. Please consult our Technical Department for more information.



## Tie back system

Most sheet pile retaining walls need supplementary support at the top, in addition to embedment in the soil. Temporary cofferdams generally use walers and struts (fixed or hydraulic) for cross-bracing inside the excavation. Permanent or large retaining walls are often tied back to an anchor wall installed at a certain distance behind the main wall. Injection anchors and anchor piles can also be used.

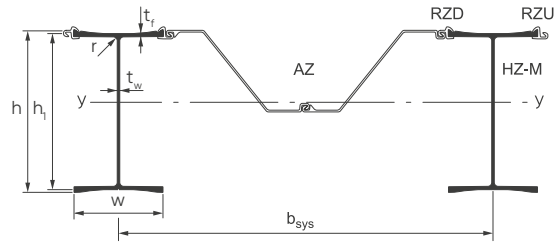
The drawing shows a typical horizontal tie-rod connection for U-section sheet pile walls.



# HZ<sup>®</sup> / AZ<sup>®</sup> combined wall system

The HZ<sup>®</sup>-M combined wall is a revolutionary system, an extremely cost-effective combined wall solution launched in 2008 to replace the former HZ/AZ system, and consists of:

- HZ<sup>®</sup>-M king piles;
- a pair of AZ<sup>®</sup> sheet piles as intermediary elements;
- special connectors (RH, RZD, RZU).



The HZ-M king piles, with milled grooves on the flanges and thicknesses up to 40 mm, fulfill two different structural functions:

- retaining members for soil and hydrostatic pressures;
- bearing piles for vertical loads.

The combinations are based on the same principle: structural supports comprising 1 or 2 HZ-M king pile sections alternating

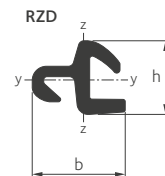
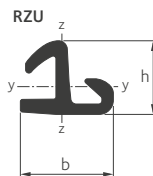
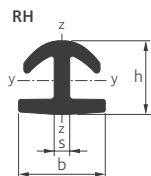
with or without intermediary double AZ sheet pile sections. The intermediary sheet piles have a soil-retaining and load-transferring function and are generally shorter than the HZ-M king piles. Depending on the combinations and steel grades adopted, the achievable bending moment capacity lies above 21 000 kNm/m ( $W_{elastic}$  up to 46 500 cm<sup>3</sup>/m).

Section (Sol. 102)	Dimensions							Torsional constant	Warping constant	Sectional area	Mass	Moment of inertia	Elastic section modulus	Coating area	Connector set
	h	h <sub>1</sub>	w	t <sub>max</sub>	t <sub>f</sub>	t <sub>w</sub>	r								
	mm	mm	mm	mm	mm	mm	mm					cm <sup>4</sup>	10 <sup>3</sup> cm <sup>6</sup>		
HZ 630M <sup>1)</sup>	631.4	615.7	420	29.0	24.2	16.0	30	569.2	28410	308.6	242.2	217460	6985	2.870	A
HZ 880M A	831.3	803.4	458	29.0	18.9	13.0	30	375.0	58600	296.6	232.8	357280	8800	3.426	A
HZ 880M B	831.3	807.4	460	29.0	20.9	15.0	30	490.1	63000	328.9	258.2	392750	9625	3.431	A
HZ 880M C	831.3	811.4	460	29.0	22.9	15.0	30	570.2	65890	343.4	269.6	416770	10170	3.431	A
HZ 1080M A	1075.3	1047.4	454	29.0	19.6	16.0	30	525.9	98560	368.7	289.4	690560	13075	3.877	A
HZ 1080M B	1075.3	1053.4	454	29.0	22.6	16.0	30	656.5	106800	391.7	307.5	754830	14205	3.878	A
HZ 1080M C	1075.3	1059.4	456	29.0	25.7	18.0	30	876.2	114500	433.7	340.5	833250	15605	3.881	A
HZ 1080M D	1075.3	1067.4	457	30.7	29.7	19.0	30	1129.1	121000	467.7	367.2	909650	16920	3.882	A
HZ 1180M A	1075.4	-	458	34.7	31.0	20.0	30	1352.9	124600	494.9	388.5	967270	17865	3.884	A
HZ 1180M B	1079.4	-	458	36.7	33.0	20.0	30	1544.3	132400	512.1	402.0	1017000	18675	3.895	A
HZ 1180M C	1083.4	-	459	38.7	35.0	21.0	30	1817.9	142600	541.2	424.9	1081070	19790	3.905	B
HZ 1180M D	1087.4	-	460	40.7	37.0	22.0	30	2110.2	150000	568.1	445.9	1138630	20690	3.919	B

## Connectors

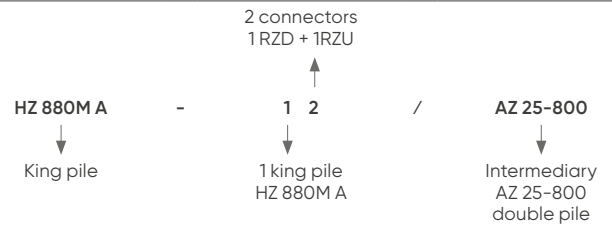
RH 16	61.8	68.2		12.2				20.1	15.8	83	25			
RZD 16	61.8	80.5						20.7	16.2	57	18			A
RZU 16	61.8	80.5						20.4	16.0	68	18			
RH 20	67.3	79.2		14.2				25.2	19.8	122	33			
RZD 18	67.3	85.0						23.0	18.0	78	22			B
RZU 18	67.3	85.0						22.6	17.8	92	22			

<sup>1)</sup> Available upon request.



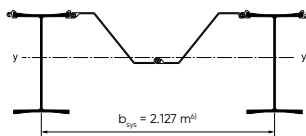
The outstanding feature of the HZ/AZ combined wall system is the extensive range of possible combinations using the entire AZ sheet pile offer, including the latest wide AZ-800 range, as well as all rolled-up and rolled-down AZ sections. The table below contains but a small sample of the available systems. Please refer to our brochure "The HZ®-M Steel Wall System" for detailed information on the entire HZ®/AZ® range.

### Denomination example of the HZ/AZ system



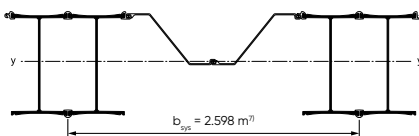
Section	Sectional area	Moment of inertia	Elastic <sup>1)</sup> section modulus	Elastic <sup>2)</sup> section modulus	Mass <sup>3)</sup>		Coating area <sup>4)</sup>
					Mass <sub>100</sub>	Mass <sub>60</sub>	
	cm <sup>2</sup> /m	cm <sup>4</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	kg/m <sup>2</sup>	kg/m <sup>2</sup>	m <sup>2</sup> /m

### Combination HZ ... M - 12 / AZ 25-800



HZ 630M <sup>5)</sup>	292.3	165710	<b>4870</b>	5455	229	184	2.70
HZ 880M A	281.5	240530	<b>5385</b>	6150	221	176	2.73
HZ 880M B	296.4	257290	<b>5790</b>	6510	233	188	2.74
HZ 880M C	303.2	268670	<b>6040</b>	6770	238	193	2.74
HZ 1080M A	316.0	418410	<b>7315</b>	8205	248	203	2.73
HZ 1080M B	326.8	449000	<b>7850</b>	8755	257	212	2.73
HZ 1080M C	346.3	485830	<b>8510</b>	9400	272	227	2.73
HZ 1080M D	362.1	521780	<b>9120</b>	10045	284	240	2.73
HZ 1180M A	374.7	548790	<b>9560</b>	10525	294	250	2.73
HZ 1180M B	382.8	572490	<b>9970</b>	10935	300	256	2.74
HZ 1180M C	398.4	607290	<b>10505</b>	11575	313	267	2.75
HZ 1180M D	410.8	634670	<b>11015</b>	12010	322	277	2.75

### Combination HZ ... M - 24 / AZ 25-800



HZ 630M <sup>5)</sup>	377.5	236070	<b>7245</b>	6665	296	259	3.18
HZ 880M A	357.5	356530	<b>8360</b>	7735	281	244	3.26
HZ 880M B	381.6	382980	<b>8985</b>	8350	300	263	3.26
HZ 880M C	392.7	401480	<b>9395</b>	8770	308	272	3.26
HZ 1080M A	414.3	646970	<b>11760</b>	11065	325	289	3.25
HZ 1080M B	431.8	695900	<b>12610</b>	11935	339	302	3.25
HZ 1080M C	463.5	755430	<b>13670</b>	13005	364	327	3.26
HZ 1080M D	489.3	813780	<b>14665</b>	14045	384	348	3.26
HZ 1180M A	509.8	857500	<b>15370</b>	14825	400	364	3.26
HZ 1180M B	522.1	893300	<b>15970</b>	15460	410	373	3.26
HZ 1180M C	549.4	955970	<b>17010</b>	16445	431	394	3.28
HZ 1180M D	567.7	994160	<b>17650</b>	17125	446	409	3.29

<sup>1)</sup> Referring outside of HZ-M flange.

<sup>2)</sup> Referring outside of RH / RZ.

<sup>3)</sup>  $L_{RH} = L_{HZ}$ ;  $L_{RZU} = L_{RZD} = L_{AZ}$ ;  $Mass_{100}$ :  $L_{AZ} = 100\% L_{HZ}$ ;  $Mass_{60}$ :  $L_{AZ} = 60\% L_{HZ}$ .

<sup>4)</sup> Excluding inside of interlocks, per system width.

<sup>5)</sup> Available upon request.

<sup>6)</sup> For HZ 630M  $b_{sys} = 2.090 \text{ m}$

<sup>7)</sup> For HZ 630M  $b_{sys} = 2.524 \text{ m}$



# AS 500<sup>®</sup> straight web sections

AS 500 straight web sheet piles are designed to form closed cylindrical structures retaining a soil fill. The stability of the cells consisting of a steel envelope and an internal body of soil is guaranteed by their own weight. Straight web sheet piles are mostly used on projects where rock layers are close to ground level or where anchoring would be difficult or impossible. Straight web sheet pile structures are made of circular cells or

diaphragm cells, depending on the site characteristics or the particular requirements of the project. The forces developing in these sheet pile sections are essentially horizontal tensile forces requiring an interlock resistance corresponding to the horizontal force in the web of the pile. AS 500 interlocks comply with EN 10248. Please refer to our brochure "AS 500<sup>®</sup> Straight web steel sheet piles - design & execution manual" for further details.

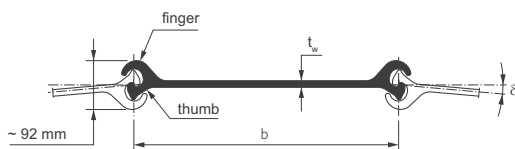
Section	Nominal width <sup>1)</sup>	Web thickness	Deviation angle <sup>2)</sup>	Perimeter	Sectional area	Mass	Mass per m <sup>2</sup> of wall	Moment of inertia	Section modulus	Coating area <sup>3)</sup>				
	<b>b</b>	<b>t<sub>w</sub></b>	<b>δ</b>								single pile		single pile	
	mm	mm	°								cm	cm <sup>2</sup>	kg/m	kg/m <sup>2</sup>
AS 500 - 9.5	500	9.5	4.5	138	81.3	63.8	<b>128</b>	168	46	0.58				
AS 500 - 11.0	500	11.0	4.5	139	89.4	70.2	<b>140</b>	186	49	0.58				
AS 500 - 12.0	500	12.0	4.5	139	94.6	74.3	<b>149</b>	196	51	0.58				
AS 500 - 12.5	500	12.5	4.5	139	97.2	76.3	<b>153</b>	201	51	0.58				
AS 500 - 12.7	500	12.7	4.5	139	98.2	77.1	<b>154</b>	204	51	0.58				
AS 500 - 13.0 <sup>4)</sup>	500	13.0	4.5	140	100.6	79.0	<b>158</b>	213	54	0.58				

<sup>1)</sup> The effective width to be taken into account for design purposes (layout) is 503 mm for all AS 500 sheet piles.

<sup>2)</sup> Max. deviation angle 4.0° for pile length > 20 m.

<sup>3)</sup> One side, excluding inside of interlocks.

<sup>4)</sup> Please contact ArcelorMittal Sheet Piling for further information.



The following characteristic interlock resistance can be guaranteed:

Section	$R_{k,s}$ [kN/m] <sup>5)</sup>
AS 500 - 9.5	3500
AS 500 - 11.0	4000
AS 500 - 12.0	5000
AS 500 - 12.5	5500
AS 500 - 12.7	5500
AS 500 - 13.0	6000

<sup>5)</sup> For the related steel grade and further information, please contact us. Testing procedure according to Annex C of EN 10248-1:2023.

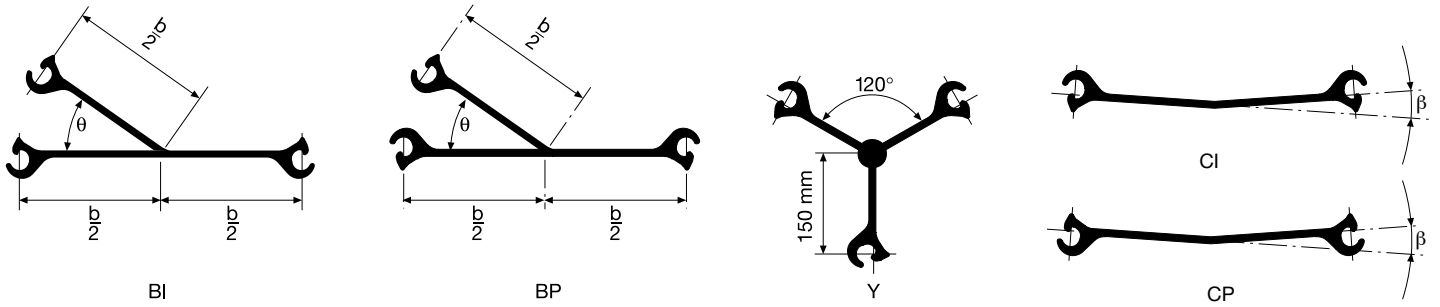
For AS 500 pile verification, both yield resistance of the web and ultimate resistance of the interlock should be checked.



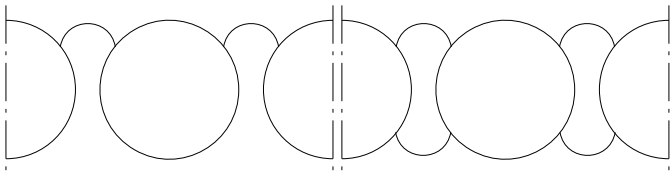
Bridge construction, South Korea

## Junction piles and bent piles

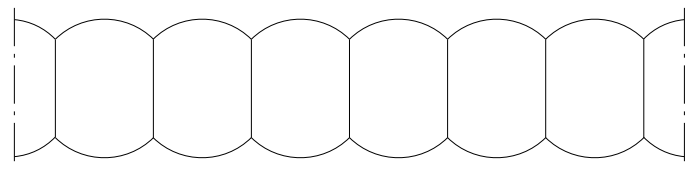
Junction piles that join circular cells and intermediary arcs can be provided. Bent piles are pre-bent at the mill. If the deviation angle exceeds  $4.5^\circ$  ( $4.0^\circ$  if  $L > 20$  m), bent piles can be used to set up structures with small radii.



## Types of cells



Circular cells with  $35^\circ$  junction piles and one or two connecting arcs.



Diaphragm cells with  $120^\circ$  junction piles.



## Circular cell construction



Installation of template



Threading until cell closure



Driving



## Equivalent width

The equivalent width  $w_e$  which is required for stability verification determines the geometry of the chosen cellular construction.

### for circular cells

The equivalent width  $w_e$  is defined as:

$$w_e = \frac{\text{Area within 1 cell} + \text{Area within 1 (or 2) arc(s)}}{\text{System length } x}$$

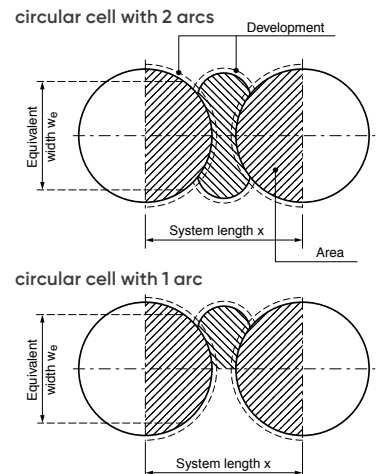
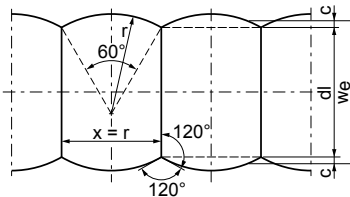
The ratio  $R_a$  indicates how economical the chosen circular cell will be. It is defined as follows

$$R_a = \frac{\text{Development 1 cell} + \text{Development 1 (or 2) arc(s)}}{\text{System length } x}$$

### for diaphragm cells

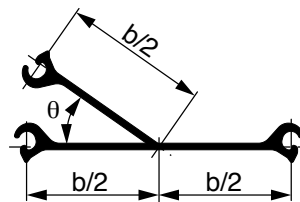
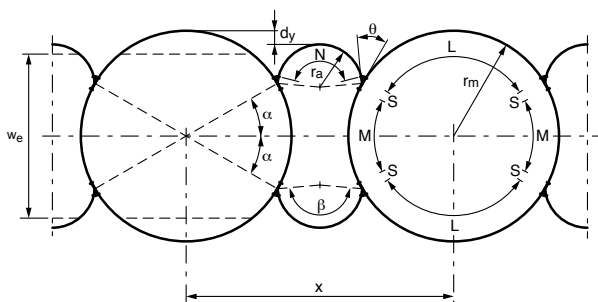
The equivalent width  $w_e$  is defined as:

$$w_e = \text{diaphragm wall length (dl)} + 2 \cdot c$$



## Geometry of circular cells

Once the equivalent width has been determined, the geometry of the cells can be defined. This can be done with the help of tables or with computer programs.



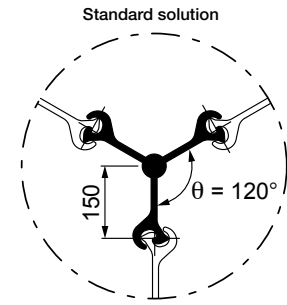
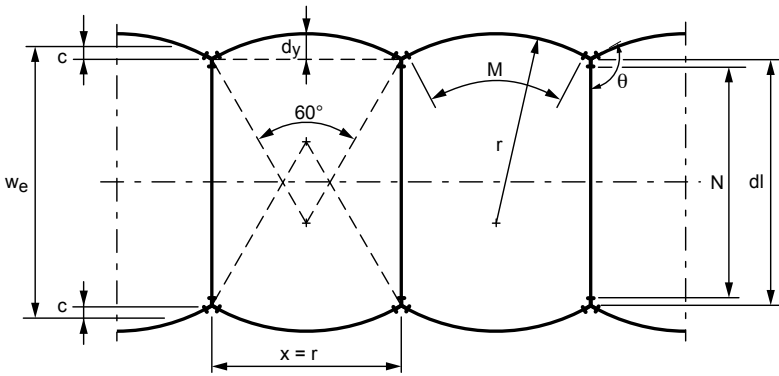
- $r_m$  = radius of the main cell
- $r_a$  = radius of the connecting arcs
- $\theta$  = angle between the main cell and the connecting arc
- $x$  = system length
- $d_y$  = positive or negative offset between the connecting arcs and the tangent planes of the main cells
- $w_e$  = equivalent width

Junction piles with angles  $\theta$  between  $30^\circ$  and  $45^\circ$ , as well as  $\theta = 90^\circ$ , are available on request.

The table below shows a short selection of circular cells with 2 arcs and standard junction piles with  $\theta = 35^\circ$ .

Nb. of piles per						Geometrical values						Interlock deviation		Design values	
Cell		Arc		System								Cell	Arc	2 Arcs	
Total	L	M	S	N		$d = 2 \cdot r_m$	$r_a$	$x$	$d_y$	$\alpha$	$\beta$	$\delta_m$	$\delta_a$	$w_e$	$R_a$
pcs.	pcs.	pcs.	pcs.	pcs.	pcs.	m	m	m	m	°	°	°	°	m	
100	33	15	1	25	150	16.01	4.47	22.92	0.16	28.80	167.60	3.60	6.45	13.69	3.34
104	35	15	1	27	158	16.65	4.88	24.42	0.20	27.69	165.38	3.46	5.91	14.14	3.30
108	37	15	1	27	162	17.29	4.94	25.23	0.54	26.67	163.33	3.33	5.83	14.41	3.27
112	37	17	1	27	166	17.93	4.81	25.25	0.33	28.93	167.86	3.21	6.00	15.25	3.35
116	37	19	1	27	170	18.57	4.69	25.27	0.13	31.03	172.07	3.10	6.15	16.08	3.42
120	39	19	1	29	178	19.21	5.08	26.77	0.16	30.00	170.00	3.00	5.67	16.54	3.38
124	41	19	1	29	182	19.85	5.14	27.59	0.50	29.03	168.06	2.90	5.60	16.82	3.35
128	43	19	1	31	190	20.49	5.55	29.09	0.53	28.13	166.25	2.81	5.20	17.27	3.32
132	43	21	1	31	194	21.13	5.42	29.11	0.33	30.00	170.00	2.73	5.31	18.10	3.39
136	45	21	1	33	202	21.77	5.82	30.61	0.36	29.12	168.24	2.65	4.95	18.56	3.35
140	45	23	1	33	206	22.42	5.71	30.62	0.17	30.86	171.71	2.57	5.05	19.39	3.42
144	47	23	1	33	210	23.06	5.76	31.45	0.50	30.00	170.00	2.50	5.00	19.67	3.39
148	47	25	1	35	218	23.70	5.99	32.13	0.00	31.62	173.24	2.43	4.81	20.67	3.44
152	49	25	1	35	222	24.31	6.05	32.97	0.34	30.79	171.58	2.37	4.77	20.95	3.42

## Geometry of diaphragm cells



- r = radius
- $\theta$  = angle between the arc and the diaphragm
- $w_e$  = equivalent width, with  $w_e = dl + 2 \cdot c$
- $d_y$  = arc height
- dl = diaphragm wall length
- x = system length
- c = equivalent arc height



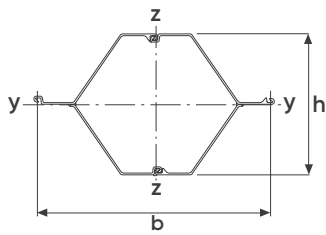
Geometry diaphragm wall

Number of piles	Wall length
N	dl
pcs.	m
11	5.83
13	6.84
15	7.85
17	8.85
19	9.86
21	10.86
23	11.87
25	12.88
27	13.88
29	14.89
31	15.89
33	16.90
35	17.91
37	18.91
39	19.92
41	20.92
43	21.93
45	22.94
47	23.94
49	24.95
51	25.95
53	26.96
55	27.97
57	28.97
59	29.98

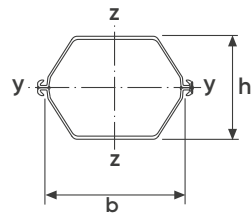
Geometry arc (Standard solution)

Number of piles	Radius System length	Arc height	Equivalent arc height	Interlock deviation
M	x = r	$d_y$	c	$\delta_a$
pcs.	m	m	m	°
11	5.57	0.75	0.51	5.17
13	6.53	0.87	0.59	4.41
15	7.49	1.00	0.68	3.85
17	8.45	1.13	0.77	3.41
19	9.41	1.26	0.86	3.06
21	10.37	1.39	0.94	2.78
23	11.33	1.52	1.03	2.54
25	12.29	1.65	1.12	2.34
27	13.26	1.78	1.20	2.17
29	14.22	1.90	1.29	2.03
31	15.18	2.03	1.38	1.90
33	16.14	2.16	1.46	1.79
35	17.10	2.29	1.55	1.69
37	18.06	2.42	1.64	1.60
39	19.02	2.55	1.73	1.52
41	19.98	2.68	1.81	1.44
43	20.94	2.81	1.90	1.38

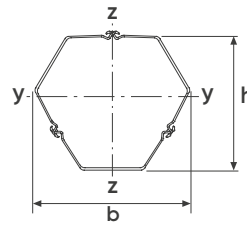
# Box piles



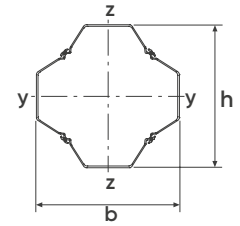
Z-box pile



Double U box pile



Triple U box pile



Quadruple U box pile

Section	Width		Perimeter	Sectional area	Total section	Mass <sup>1)</sup>	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area <sup>2)</sup>
	b	h					y-y	z-z	y-y	z-z		
	mm	mm										

## CAZ-800 box piles

CAZ 18-800	1600	898	438	363	7340	<b>285</b>	339470	650340	<b>7535</b>	<b>7915</b>	30.6	4.16
CAZ 20-800	1600	900	438	400	7372	<b>314</b>	372430	713410	<b>8250</b>	<b>8690</b>	30.5	4.16
CAZ 22-800	1600	902	439	436	7404	<b>342</b>	405710	776690	<b>8965</b>	<b>9465</b>	30.5	4.16
CAZ 23-800	1600	948	445	423	7764	<b>332</b>	447370	756450	<b>9405</b>	<b>9170</b>	32.5	4.24
CAZ 25-800	1600	950	446	460	7796	<b>361</b>	484690	820800	<b>10170</b>	<b>9990</b>	32.5	4.24
CAZ 27-800	1600	952	446	497	7829	<b>390</b>	522220	885310	<b>10930</b>	<b>10750</b>	32.4	4.24

## CAZ-750 box piles

CAZ 28-750	1500	1018	445	453	7829	<b>356</b>	547100	702950	<b>10715</b>	<b>9080</b>	34.8	4.23
CAZ 30-750	1500	1020	446	490	7861	<b>385</b>	590180	758880	<b>11535</b>	<b>9840</b>	34.7	4.23
CAZ 32-750	1500	1022	446	527	7892	<b>414</b>	633500	815060	<b>12360</b>	<b>10535</b>	34.7	4.23

## CAZ-700 and CAZ-770 box piles

CAZ 12-770	1540	687	389	328	5431	<b>257</b>	175060	557990	<b>5075</b>	<b>6985</b>	23.1	3.67
CAZ 13-770	1540	688	389	344	5446	<b>270</b>	183440	584640	<b>5310</b>	<b>7320</b>	23.1	3.67
CAZ 14-770	1540	689	390	360	5461	<b>283</b>	191840	611300	<b>5545</b>	<b>7655</b>	23.1	3.67
CAZ 14-770 -10/10	1540	690	390	376	5476	<b>295</b>	200280	637960	<b>5780</b>	<b>7995</b>	23.1	3.67
CAZ 12-700	1400	628	360	303	4524	<b>238</b>	137770	421600	<b>4365</b>	<b>5785</b>	21.3	3.39
CAZ 13-700	1400	630	361	332	4552	<b>261</b>	150890	461210	<b>4765</b>	<b>6335</b>	21.3	3.39
CAZ 13-700-10/10	1400	631	361	347	4565	<b>272</b>	157530	481090	<b>4965</b>	<b>6610</b>	21.3	3.39
CAZ 14-700	1400	632	361	362	4579	<b>284</b>	164130	500820	<b>5165</b>	<b>6885</b>	21.3	3.39
CAZ 17-700	1400	839	391	330	6015	<b>259</b>	265280	457950	<b>6300</b>	<b>6285</b>	28.3	3.69
CAZ 18-700	1400	840	391	347	6029	<b>272</b>	277840	479790	<b>6590</b>	<b>6590</b>	28.3	3.69
CAZ 20-700	1400	842	392	379	6058	<b>297</b>	303090	523460	<b>7170</b>	<b>7195</b>	28.3	3.69
CAZ 24-700	1400	918	407	436	6616	<b>342</b>	412960	596900	<b>8965</b>	<b>8260</b>	30.8	3.85
CAZ 26-700	1400	920	407	469	6645	<b>368</b>	444300	641850	<b>9625</b>	<b>8900</b>	30.8	3.85
CAZ 28-700	1400	922	408	503	6674	<b>395</b>	475810	686880	<b>10285</b>	<b>9510</b>	30.8	3.85

<sup>1)</sup> The mass of the welds is not taken into account.

<sup>2)</sup> Outside surface, excluding inside of interlocks.

Section	Width	Height	Perimeter	Sectional area	Total section	Mass <sup>1)</sup>	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area <sup>2)</sup>
	b	h					y-y	z-z	y-y	z-z		
	mm	mm					cm <sup>4</sup>	cm <sup>4</sup>	cm <sup>3</sup>	cm <sup>3</sup>		

**CAZ-700 and CAZ-770 box piles**

CAZ 36-700N	1400	998	434	534	7215	419	627000	710770	12525	9895	34.3	4.12
CAZ 38-700N	1400	1000	435	570	7245	447	667900	757530	13315	10550	34.2	4.12
CAZ 40-700N	1400	1002	436	606	7275	476	709010	804300	14105	11205	34.2	4.12
CAZ 42-700N	1400	998	433	646	7267	507	744440	855860	14870	11915	34.0	4.11
CAZ 44-700N	1400	1000	434	682	7298	535	785620	902800	15660	12570	33.9	4.11
CAZ 46-700N	1400	1002	434	718	7328	564	827030	949760	16455	13225	33.9	4.11
CAZ 48-700	1400	1006	435	710	7346	558	845530	931330	16745	12965	34.5	4.13
CAZ 50-700	1400	1008	435	746	7376	586	887420	977550	17540	13620	34.5	4.13
CAZ 52-700	1400	1010	436	782	7406	614	929550	1023800	18335	14255	34.5	4.13

**CAZ box piles**

CAZ 18	1260	760	361	333	4925	261	222930	365500	5840	5560	25.9	3.41
CAZ 26	1260	854	377	440	5566	346	366820	480410	8555	7385	28.9	3.57

<sup>1)</sup> The mass of the welds is not taken into account.

<sup>2)</sup> Outside surface, excluding inside of interlocks.



Wrocław flood protection system, Poland

Section	Width		Perimeter	Sectional area	Total section	Mass <sup>1)</sup>	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area <sup>2)</sup>
	b	h					y-y	z-z	y-y	z-z		
	mm	mm										

### CAU double box piles

CAU 14-2	750	451	230	198	2598	<b>155.8</b>	54400	121490	<b>2415</b>	<b>3095</b>	16.6	2.04
CAU 16-2	750	454	231	220	2620	<b>172.5</b>	62240	130380	<b>2745</b>	<b>3325</b>	16.8	2.04
CAU 18-2	750	486	239	225	2888	<b>177.0</b>	73770	142380	<b>3035</b>	<b>3625</b>	18.1	2.14
CAU 20-2	750	489	240	247	2910	<b>193.8</b>	83370	151220	<b>3405</b>	<b>3850</b>	18.4	2.14
CAU 23-2	750	492	244	260	3013	<b>204.2</b>	94540	157900	<b>3845</b>	<b>4020</b>	19.1	2.19
CAU 25-2	750	495	245	281	3034	<b>220.8</b>	104810	166600	<b>4235</b>	<b>4240</b>	19.3	2.19

### CU double box piles

CU 12-2	600	403	198	168	1850	<b>132.2</b>	34000	70000	<b>1685</b>	<b>2205</b>	14.2	1.72
CU 12S-2	600	405	198	181	1867	<b>142.1</b>	36120	76410	<b>1785</b>	<b>2410</b>	14.1	1.72
CU 18-2	600	473	212	196	2184	<b>153.8</b>	58020	78300	<b>2455</b>	<b>2470</b>	17.2	1.86
CU 22-2	600	494	220	219	2347	<b>172.3</b>	73740	88960	<b>2985</b>	<b>2800</b>	18.3	1.94
CU 28-2	600	499	226	259	2468	<b>203.6</b>	96000	103560	<b>3850</b>	<b>3260</b>	19.2	2.00
CU 32-2	600	499	223	291	2461	<b>228.3</b>	108800	109200	<b>4360</b>	<b>3435</b>	19.3	1.97

### CGU double box piles

CGU 7N-2	600	348	187	112	1596	<b>88.2</b>	16510	48530	<b>950</b>	<b>1535</b>	12.1	1.62
CGU 7S-2	600	349	188	118	1604	<b>92.5</b>	18210	50630	<b>1045</b>	<b>1605</b>	12.3	1.62
CGU 11N-2	600	359	193	153	1707	<b>120.4</b>	27670	60590	<b>1540</b>	<b>1915</b>	13.4	1.67
CGU 14N-2	600	461	205	164	2079	<b>128.6</b>	44070	65550	<b>1910</b>	<b>2075</b>	16.4	1.79
CGU 18N-2	600	473	212	196	2184	<b>153.8</b>	58020	78300	<b>2455</b>	<b>2470</b>	17.2	1.86
CGU 22N-2	600	494	220	219	2347	<b>172.3</b>	73740	88960	<b>2985</b>	<b>2800</b>	18.3	1.94
CGU 28N-2	600	499	226	259	2468	<b>203.6</b>	96000	103560	<b>3850</b>	<b>3260</b>	19.2	2.00
CGU 32N-2	600	499	223	291	2461	<b>228.3</b>	108800	109200	<b>4360</b>	<b>3435</b>	19.3	1.97
CGU 16-400-2	400	336	169	158	1170	<b>123.9</b>	25270	31900	<b>1505</b>	<b>1465</b>	12.7	1.40

<sup>1)</sup> The mass of the welds is not taken into account.

<sup>2)</sup> Outside surface, excluding inside of interlocks.

Section	Width	Height	Perimeter	Sectional area	Total section	Mass <sup>1)</sup>	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area <sup>2)</sup>
	b	h					y-y	z-z	y-y	z-z		
	mm	mm					cm <sup>4</sup>	cm <sup>4</sup>	cm <sup>3</sup>	cm <sup>3</sup>		

**CAU triple box piles**

CAU 14-3	957	908	341	298	6454	<b>233.7</b>	300330	<b>6510</b>	<b>6275</b>	31.7	3.03
CAU 16-3	960	910	342	330	6486	<b>258.7</b>	333640	<b>7235</b>	<b>6955</b>	31.8	3.03
CAU 18-3	1009	927	355	338	6886	<b>265.5</b>	363690	<b>7825</b>	<b>7205</b>	32.8	3.17
CAU 20-3	1012	928	356	370	6919	<b>290.7</b>	399780	<b>8570</b>	<b>7900</b>	32.9	3.17
CAU 23-3	1036	930	361	390	7073	<b>306.3</b>	431940	<b>9235</b>	<b>8340</b>	33.3	3.24
CAU 25-3	1038	931	364	422	7106	<b>331.3</b>	469030	<b>9995</b>	<b>9035</b>	33.3	3.24

**CU triple box piles**

CU 12-3	800	755	293	253	4431	<b>198.3</b>	173100	<b>4555</b>	<b>4325</b>	26.2	2.54
CU 12S-3	802	756	294	271	4457	<b>213.1</b>	186260	<b>4890</b>	<b>4645</b>	26.2	2.54
CU 18-3	877	790	315	294	4931	<b>230.7</b>	227330	<b>5475</b>	<b>5185</b>	27.8	2.76
CU 22-3	912	801	326	329	5174	<b>258.4</b>	268440	<b>6310</b>	<b>5890</b>	28.6	2.87
CU 28-3	938	817	336	389	5356	<b>305.4</b>	330290	<b>7720</b>	<b>7040</b>	29.1	2.96
CU 32-3	926	809	331	436	5345	<b>342.4</b>	367400	<b>8585</b>	<b>7935</b>	29.0	2.92

**CGU triple box piles**

CGU 11N-3	781	730	285	230	4206	<b>180.7</b>	150670	<b>4040</b>	<b>3860</b>	25.6	2.47
CGU 14N-3	844	781	305	246	4763	<b>192.8</b>	182730	<b>4475</b>	<b>4330</b>	27.3	2.65
CGU 18N-3	877	790	315	294	4931	<b>230.7</b>	227330	<b>5475</b>	<b>5185</b>	27.8	2.76
CGU 22N-3	912	801	326	329	5174	<b>258.4</b>	268440	<b>6310</b>	<b>5890</b>	28.6	2.87
CGU 28N-3	938	817	336	389	5356	<b>305.4</b>	330290	<b>7720</b>	<b>7040</b>	29.1	2.96
CGU 32N-3	926	809	331	436	5345	<b>342.4</b>	367400	<b>8585</b>	<b>7935</b>	29.0	2.92

<sup>1)</sup> The mass of the welds is not taken into account.

<sup>2)</sup> Outside surface, excluding inside of interlocks.



Section	Width	Height	Perimeter	Sectional area	Total section	Mass <sup>1)</sup>	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area <sup>2)</sup>
	b	h					y-y	z-z	y-y	z-z		
	mm	mm										

### CAU quadruple box piles

CAU 14-4	1222	1222	453	397	11150	<b>311.6</b>	692030	<b>11325</b>	41.7	4.02
CAU 16-4	1225	1225	454	440	11193	<b>345.0</b>	770370	<b>12575</b>	41.8	4.02
CAU 18-4	1258	1258	471	451	11728	<b>354.0</b>	826550	<b>13140</b>	42.8	4.20
CAU 20-4	1261	1261	472	494	11771	<b>387.6</b>	910010	<b>14430</b>	42.9	4.20
CAU 23-4	1263	1263	481	520	11977	<b>408.4</b>	979870	<b>15510</b>	43.4	4.30
CAU 25-4	1266	1266	482	563	12020	<b>441.6</b>	1064910	<b>16820</b>	43.5	4.30

### CU quadruple box piles

CU 12-4	1025	1025	388	337	7565	<b>264.4</b>	394000	<b>7690</b>	34.2	3.36
CU 12S-4	1027	1027	389	362	7598	<b>284.1</b>	423410	<b>8250</b>	34.2	3.36
CU 18-4	1095	1095	417	392	8231	<b>307.6</b>	507240	<b>9270</b>	36.0	3.65
CU 22-4	1115	1115	432	439	8556	<b>344.6</b>	593030	<b>10635</b>	36.8	3.80
CU 28-4	1120	1120	445	519	8799	<b>407.2</b>	725730	<b>12955</b>	37.4	3.93
CU 32-4	1120	1120	440	582	8782	<b>456.6</b>	811100	<b>14480</b>	37.3	3.87

### CGU quadruple box piles

CGU 11N-4	979	979	379	307	7254	<b>240.9</b>	347050	<b>7095</b>	33.6	3.27
CGU 14N-4	1081	1081	404	328	7997	<b>257.1</b>	409870	<b>7585</b>	35.4	3.51
CGU 18N-4	1095	1095	417	392	8231	<b>307.6</b>	507240	<b>9270</b>	36.0	3.65
CGU 22N-4	1115	1115	432	439	8556	<b>344.6</b>	593030	<b>10635</b>	36.8	3.80
CGU 28N-4	1120	1120	445	519	8799	<b>407.2</b>	725730	<b>12955</b>	37.4	3.93
CGU 32N-4	1120	1120	440	582	8782	<b>456.6</b>	811100	<b>14480</b>	37.3	3.87

<sup>1)</sup> The mass of the welds is not taken into account.

<sup>2)</sup> Outside surface, excluding inside of interlocks.



Changxin dry dock, Shanghai, China

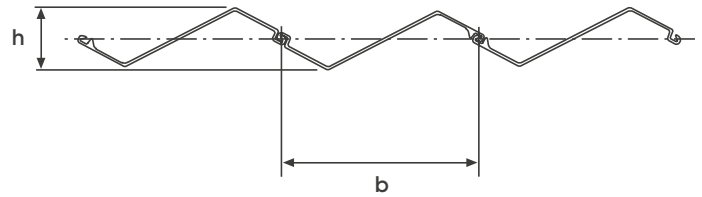


Vilanova, Barcelona, Spain

# Jagged wall

AZ<sup>®</sup> jagged wall: AZ<sup>®</sup> sections threaded in reverse may form arrangements for special applications.

The jagged wall arrangement represents a very economical solution for sealing screens (reduced height, reliable thickness, low driving resistance).



## AZ<sup>®</sup> jagged wall

Section	Width	Height	Sectional area	Mass	Moment of inertia	Elastic section modulus	Coating area <sup>1)</sup>
	b	h					
	mm	mm	cm <sup>2</sup> /m	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m	m <sup>2</sup> /m <sup>2</sup>
<b>AZ-800</b>							
AZ 18-800	897	242	115	<b>90</b>	4780	<b>395</b>	1.16
AZ 20-800	897	243	126	<b>99</b>	5340	<b>440</b>	1.16
AZ 22-800	897	244	137	<b>107</b>	5900	<b>485</b>	1.16
AZ 23-800	907	255	133	<b>104</b>	6070	<b>475</b>	1.17
AZ 25-800	907	257	144	<b>113</b>	6670	<b>520</b>	1.17
AZ 27-800	907	258	155	<b>122</b>	7260	<b>565</b>	1.17
<b>AZ-750</b>							
AZ 28-750	881	278	146	<b>114</b>	7970	<b>575</b>	1.20
AZ 30-750	881	280	157	<b>123</b>	8690	<b>620</b>	1.20
AZ 32-750	881	281	169	<b>132</b>	9420	<b>670</b>	1.20
<b>AZ-700 and AZ-770</b>							
AZ 12-770	826	181	112	<b>88</b>	2320	<b>255</b>	1.12
AZ 13-770	826	182	117	<b>92</b>	2450	<b>270</b>	1.12
AZ 14-770	826	182	123	<b>96</b>	2590	<b>285</b>	1.12
AZ 14-770-10/10	826	183	128	<b>100</b>	2720	<b>295</b>	1.12
AZ 12-700	751	182	115	<b>90</b>	2400	<b>265</b>	1.13
AZ 13-700	751	183	126	<b>99</b>	2680	<b>295</b>	1.13
AZ 13-700-10/10	751	183	131	<b>103</b>	2820	<b>305</b>	1.13
AZ 14-700	751	184	136	<b>107</b>	2960	<b>320</b>	1.13
AZ 17-700	795	224	117	<b>92</b>	3690	<b>330</b>	1.16
AZ 18-700	795	224	123	<b>96</b>	3910	<b>350</b>	1.16
AZ 19-700	795	225	128	<b>101</b>	4120	<b>365</b>	1.16
AZ 20-700	795	225	134	<b>105</b>	4340	<b>385</b>	1.16
AZ 24-700	813	241	150	<b>118</b>	5970	<b>495</b>	1.19
AZ 26-700	813	242	161	<b>127</b>	6490	<b>535</b>	1.19
AZ 28-700	813	243	172	<b>135</b>	7020	<b>580</b>	1.19

<sup>1)</sup> One side, excluding inside of interlocks.



Section	Width	Height	Sectional area	Mass	Moment of inertia	Elastic section modulus	Coating area <sup>1)</sup>
	b	h					
	mm	mm	cm <sup>2</sup> /m	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m	m <sup>2</sup> /m <sup>2</sup>

### AZ-700 and AZ-770

AZ 36-700N	834	296	181	142	11900	805	1.23
AZ 38-700N	834	298	193	152	12710	855	1.23
AZ 40-700N	834	299	205	161	13530	905	1.23
AZ 42-700N	834	301	217	170	14730	975	1.24
AZ 44-700N	834	303	229	180	15550	1025	1.24
AZ 46-700N	834	304	241	189	16370	1075	1.24
AZ 48-700	836	303	242	190	16290	1075	1.23
AZ 50-700	836	303	253	199	17100	1130	1.23
AZ 52-700	836	305	265	208	17900	1175	1.23

### AZ

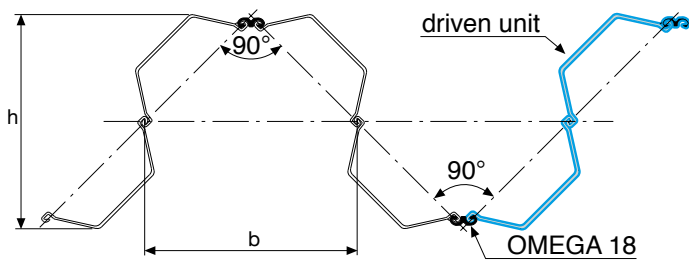
AZ 18	714	225	133	104	4280	380	1.19
AZ 18-10/10	714	225	139	109	4500	400	1.19
AZ 26	736	238	169	133	6590	555	1.21

<sup>1)</sup> One side, excluding inside of interlocks.



Temporary trench, Brenner railway, Austria

## U jagged wall



An arrangement of U-sheet piles forming a jagged wall offers economical solutions where high inertia and section modulus are needed. The final choice of section has to include drivability criteria. The mechanical values given below assume that the driven unit is crimped or welded. The OMEGA 18 section is normally threaded and welded at the mill, either by tack weld (no contribution to the section modulus of the jagged wall) or by an appropriately designed weld (full contribution to the section modulus). For walls with an anchorage or strut system, stiffeners have to be provided at the support levels.

Section	Width	Height	Mass	Moment of inertia <sup>1)</sup>		Elastic section modulus <sup>1)</sup>		Static moment	
	b	h		without Omega 18	with Omega 18	without Omega 18	with Omega 18	without Omega 18	with Omega 18
	mm	mm		cm <sup>4</sup> /m	cm <sup>4</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m

### AU™ jagged wall

AU 14	1135	1115	153	275920	334450	5080	5995	3080	3625
AU 16	1135	1115	168	307090	365630	5650	6555	3435	3980
AU 18	1135	1136	172	329420	387960	5800	6830	3595	4135
AU 20	1135	1139	187	362620	421160	6370	7400	3960	4505
AU 23	1135	1171	196	390770	449300	6675	7675	4235	4780
AU 25	1135	1173	210	424630	483170	7240	8240	4610	5150

### PU® jagged wall

PU 12	923	903	163	188980	235400	4275	5210	2590	3125
PU 12S	923	903	174	202370	248810	4570	5510	2770	3305
PU 18	923	955	186	244470	290890	5120	6095	3215	3755
PU 22	923	993	206	286030	332460	5760	6695	3690	4230
PU 28	923	1027	240	349890	396310	6810	7715	4465	5000
PU 32	923	1011	267	389310	435740	7705	8625	5015	5550

### GU® jagged wall

GU 11N	923	903	150	167340	213770	3790	4735	2335	2875
GU 14N	923	920	159	198710	245140	4320	5330	2645	3180
GU 18N	923	955	186	244470	290890	5120	6095	3215	3755
GU 22N	923	993	206	286030	332460	5760	6695	3690	4230
GU 28N	923	1027	240	349890	396310	6810	7715	4465	5000
GU 32N	923	1011	267	389310	435740	7705	8625	5015	5550

<sup>1)</sup> The moment of inertia and elastic section moduli assume correct shear force transfer across the interlock on the neutral axis.

# Combined walls

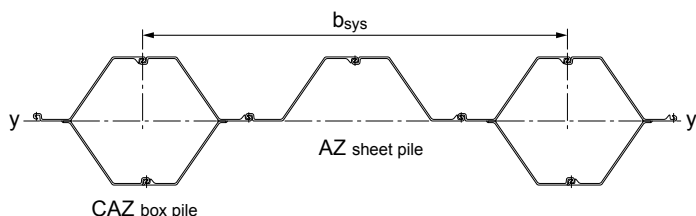
Steel sheet piles can easily be combined to form special arrangements and create systems with large bending resistance:

- box piles / sheet piles;
- HZ<sup>®</sup>-M king piles / sheet piles;
- tubular king piles / sheet piles.

The primary piles or "king piles" of combined walls can also be used as bearing piles submitted to high vertical loads, e.g. crane loads. The intermediary sheet piles act mainly as soil-retaining and load-transferring elements.

## Equivalent elastic section modulus

The equivalent elastic section modulus  $W_{sys}$  per linear metre of combined wall is based on the assumption that the deflections of king piles and intermediary steel sheet piles are the same, leading to the following formulas:



$$I_{sys} = \frac{I_{king\ pile} + I_{ssp}}{b_{sys}}$$

$$W_{sys} = \frac{W_{king\ pile}}{b_{sys}} \cdot \left( \frac{I_{king\ pile} + I_{ssp}}{I_{king\ pile}} \right)$$

$I_{sys}$	[cm <sup>4</sup> /m]:	Moment of inertia of combined wall
$W_{sys}$	[cm <sup>3</sup> /m]:	Elastic section modulus of combined wall
$I_{king\ pile}$	[cm <sup>4</sup> ]:	Moment of inertia of king pile
$I_{ssp}$	[cm <sup>4</sup> ]:	Moment of inertia of intermediary sheet pile
$W_{king\ pile}$	[cm <sup>3</sup> ]:	Elastic section modulus of king pile
$b_{sys}$	[m]:	System width

## CAZ box piles – AZ<sup>®</sup> sheet piles

Combination	System width		Mass <sup>1)</sup>		Moment of inertia	Elastic section modulus
	$b_{sys}$		Mass <sub>100</sub>	Mass <sub>60</sub>	$I_{sys}$	$W_{sys}$
	mm		kg/m <sup>2</sup>	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m

### AZ-800

CAZ 20-800 / AZ 13-770	3140		148	129	129580	2870
CAZ 20-800 / AZ 18-700	3000		156	135	141780	3140
CAZ 20-800 / AZ 20-800	3200		153	131	138910	3075
CAZ 25-800 / AZ 13-770	3140		163	144	165330	3470
CAZ 25-800 / AZ 18-700	3000		171	151	179200	3760
CAZ 25-800 / AZ 20-800	3200		168	146	173990	3650

### AZ-750

CAZ 30-750 / AZ 13-770	3040		177	157	205470	4015
CAZ 30-750 / AZ 18-700	2900		185	164	221760	4335
CAZ 30-750 / AZ 20-800	3100		181	158	213630	4175

### AZ-700 and AZ-770

CAZ 13-770 / AZ 13-770	3080		137	117	70740	2045
CAZ 13-700 / AZ 13-700	2800		146	125	64160	2025
CAZ 18-700 / AZ 13-770	2940		144	124	106220	2520
CAZ 18-700 / AZ 13-700	2800		150	129	109500	2595
CAZ 18-700 / AZ 18-700	2800		152	130	118130	2800

<sup>1)</sup> Mass<sub>100</sub>: L<sub>AZ</sub> = 100% L<sub>box pile</sub>; Mass<sub>60</sub>: L<sub>AZ</sub> = 60% L<sub>box pile</sub>.

## CAZ box piles – AZ<sup>®</sup> sheet piles

Combination	System width	Mass <sup>1)</sup>		Moment of inertia	Elastic section modulus
	$b_{sys}$	Mass <sub>100</sub>	Mass <sub>60</sub>	$I_{sys}$	$W_{sys}$
	mm	kg/m <sup>2</sup>	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m
<b>AZ-700 and AZ-770</b>					
CAZ 26-700 / AZ 13-770	2940	177	156	162840	3530
CAZ 26-700 / AZ 13-700	2800	185	163	168950	3660
CAZ 26-700 / AZ 18-700	2800	186	164	177580	3845
CAZ 38-700N / AZ 13-770	2940	204	183	238890	4760
CAZ 38-700N / AZ 13-700	2800	213	192	248800	4960
CAZ 38-700N / AZ 18-700	2800	214	193	257440	5130
CAZ 44-700N / AZ 13-770	2940	234	213	278930	5560
CAZ 44-700N / AZ 13-700	2800	244	223	290850	5800
CAZ 44-700N / AZ 18-700	2800	246	224	299480	5970
CAZ 50-700 / AZ 13-770	2940	251	230	313560	6200
CAZ 50-700 / AZ 18-700	2800	264	242	335840	6640
CAZ 50-700 / AZ 20-800	3000	254	231	319830	6320
<b>AZ</b>					
CAZ 18 / AZ 18	2520	163	139	105560	2765
CAZ 26 / AZ 18	2520	196	173	162660	3795

<sup>1)</sup> Mass<sub>100</sub>: L<sub>AZ</sub> = 100% L<sub>box pile</sub>; Mass<sub>60</sub>: L<sub>AZ</sub> = 60% L<sub>box pile</sub>.

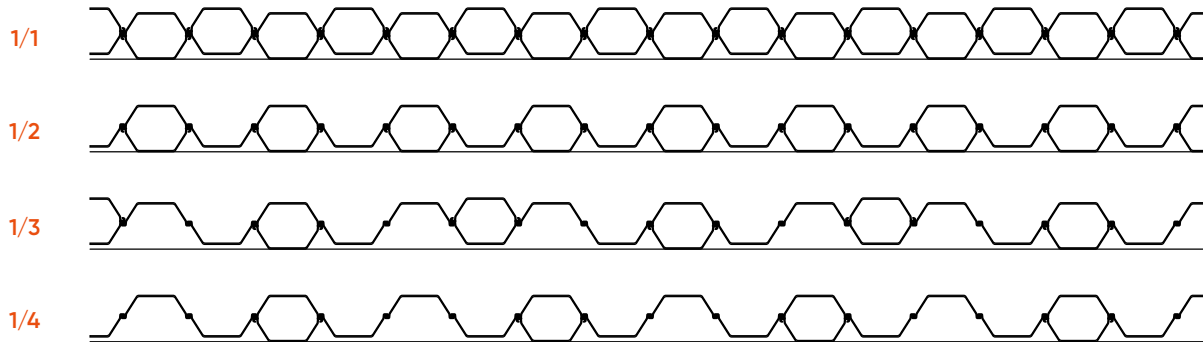


## U box piles – U sheet piles

Type of reinforcement:

- Heightwise: full or partial height;
- Lengthwise: total length 1/1 or partial length 1/2, 1/3, 1/4.

Please contact our Technical Department for other combinations (e.g. 2/4).



Section	1/1			1/2			1/3			1/4		
	Mass	Moment of inertia	Elastic section modulus	Mass	Moment of inertia	Elastic section modulus	Mass	Moment of inertia	Elastic section modulus	Mass	Moment of inertia	Elastic section modulus
	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m	kg/m <sup>2</sup>	cm <sup>4</sup> /m	cm <sup>3</sup> /m

### CAU box piles / AU™ sheet piles

AU 14	208	72530	3220	156	40660	1805	139	43300	1920	130	37980	1550
AU 16	230	82990	3660	173	46230	2035	153	49560	2185	144	43440	1755
AU 18	236	98360	4045	177	55020	2260	157	58990	2425	148	51760	1950
AU 20	258	111160	4545	194	61830	2525	172	66680	2725	162	58460	2180
AU 23	272	126050	5125	204	69580	2830	182	75820	3080	170	66410	2435
AU 25	294	139750	5645	221	76800	3105	196	84080	3395	184	73590	2675

### CU box piles / PU® sheet piles

PU 12	220	56670	2810	165	32080	1590	147	33290	1650	138	29190	1370
PU 12S	237	60200	2975	178	34120	1685	158	35170	1735	148	30830	1450
PU 18	256	96700	4090	192	54370	2300	171	58000	2450	160	50940	1980
PU 22	287	122900	4975	215	68730	2785	192	73940	2995	180	64920	2395
PU 28	339	160000	6415	255	88390	3545	226	96310	3860	212	84370	3050
PU 32	381	181330	7270	285	99790	4000	254	108660	4355	238	95070	3445

### CGU box piles / GU® sheet piles

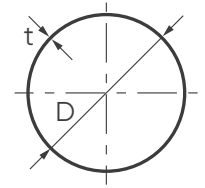
GU 7N	147	27520	1585	110	15630	900	98	16140	930	92	14160	775
GU 7S	154	30350	1740	116	17150	985	103	17810	1020	96	15610	845
GU 11N	201	46120	2570	151	25790	1435	134	27000	1505	125	23610	1235
GU 14N	214	73440	3185	161	41520	1800	143	44090	1915	134	38760	1550
GU 18N	256	96700	4090	192	54370	2300	171	58000	2450	160	50940	1980
GU 22N	287	122900	4975	215	68730	2785	192	73940	2995	180	64920	2395
GU 28N	339	160000	6415	255	88390	3545	226	96310	3860	212	84370	3050
GU 32N	381	181330	7270	285	99790	4000	254	108660	4355	238	95070	3445
GU 16-400	310	63180	3760	232	35270	2100	207	36110	2150	194	31460	1805

# Steel tubes for foundations

ArcelorMittal manufactures spirally welded tubular foundation piles in its mill located in Dintelmond, The Netherlands, with diameters up to 3000 mm, wall thicknesses up to 25 mm, and lengths up to 53 m (without butt-welding). The mill is located on the waterfront and owns a deep-water quay wall.

Tubular piles are available in numerous European and US steel grades thanks to ArcelorMittal's worldwide network

of coil producers. Tubes can be coated on the premises on request. The table below gives an overview of steel tubes used in foundations (bearing piles, combined walls, etc). Other dimensions available upon request.



Steel tubes can also be provided with C9 connectors welded on the tube to form combined wall systems<sup>1)</sup>. Tubular piles are the main retaining elements of the combined wall, carrying horizontal loads from soil and water pressures, and vertical loads from the anchors and superstructure.

The intermediary sheet piles (preferably AZ sheet piles) transfer horizontal loads to the tubular piles. Please refer to our brochure "AZ® sheet piles in combined walls" for more information on the infill sheet piles. Please refer to our brochure "Spirally welded steel pipes" for further details on steel tubes.

Diameter	Thickness	Moment of inertia	Elastic section modulus	Sectional area	Mass
D	t	I	W	A	G
mm	mm	cm <sup>4</sup>	cm <sup>3</sup>	cm <sup>2</sup>	kg/m
914	10.0	290150	6350	284.0	222.9
914	12.0	345890	7570	340.0	266.9
914	14.0	400890	8770	395.8	310.7
1016	12.0	476980	9390	378.5	297.1
1016	14.0	553190	10890	440.7	346.0
1016	16.0	628480	12370	502.7	394.6
1219	14.0	962070	15785	530.0	416.0
1219	16.0	1094090	17950	604.7	474.7
1219	18.0	1224780	20095	679.1	533.1
1422	16.0	1746590	24565	706.7	554.8
1422	18.0	1956610	27520	793.9	623.2
1422	20.0	2164820	30450	880.9	691.5
1524	16.0	2154930	28280	758.0	595.0
1524	18.0	2414730	31690	851.6	668.5
1524	20.0	2672450	35070	945.0	741.8
1626	18.0	2939310	36155	909.3	713.8
1626	20.0	3253820	40020	1009.1	792.1
1626	22.0	3565970	43860	1108.6	870.3
1829	18.0	4198850	45915	1024.1	803.9
1829	20.0	4650060	50850	1136.6	892.3
1829	22.0	5098250	55750	1248.9	980.4
2032	20.0	6397590	62970	1264.2	992.4
2032	22.0	7016540	69060	1389.2	1090.5
2032	24.0	7631750	75115	1514.0	1188.5
2540	21.0	13182380	103800	1661.9	1304.6
2540	23.0	14403690	113415	1818.7	1427.7
2540	25.0	15619130	122985	1975.3	1550.6
2845	21.0	18573651	130570	1863.1	1462.5
2845	23.0	20299605	142704	2039.1	1600.7
2845	25.0	22018177	154785	2214.8	1738.6

<sup>1)</sup> Disclaimer: ArcelorMittal Sheet Piling highly recommends that Z or U sections used in tube combined walls as infill sheet piles are threaded with C9 connectors. Infill sheet piles threaded to C9 connectors are a proven solution with respect to optimum interlock fitting. In the event of use of a connector other than the C9, ArcelorMittal Commercial RPS S.à r.l. cannot be held liable for any related failure during construction such as and not limited to, increased friction during driving or declutching.

# Driving caps

A driving cap is a very important accessory, providing efficient energy transfer between the hammer and the sheet pile section, thus preventing damage to the pile. Impact hammers need special driving caps. Driving caps for diesel hammers are generally made of cast steel, with an arrangement of guiding grooves for the different sheet pile sections on its lower side.

A dolly is fitted into a recess on the top of the driving cap. Dollies are normally made of wooden or plastic components or a combination of several different elements. Each driving cap fits for several sheet pile sections, thus the number of required driving caps for a given sheet pile range is reduced.

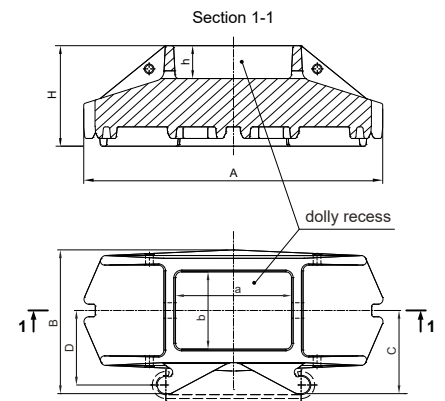
## Driving cap dimensions

Driving caps	A	B	H	C	D	Mass	Dimensions of dolly recess	Corresponding sliding guide
	mm	mm	mm	mm	mm	kg	a/b/h or ø/h	
AUS 14-26	740	580	370	350	305	650	500/300/120	500/90
AUD 12-16	1540	750	520	430	385	1900	600/400/170	700/90
AUD 20-32	1570	750	520	430	385	2100	600/400/170	700/90
PUS	680	600	320	290	265	300	380/380/120	330/50
US-B	680	600	320	290	265	300	380/380/120	330/50
UD 1	1250	610	420	260	350	1000	ø 400/170	30 <sup>2)</sup>
UD 2	1250	720	420	315	405	1250	ø 500/170	30 <sup>2)</sup>
PUD 17-33	1250	720	420	315	405	1250	ø 500/170	30 <sup>2)</sup>
A 18/26	1160	660	420	390	345	1150	600/400/170	500/90
AZD 12-14	1300	590	520	360	315	1700	600/300/170	700/90
AZD 12-14 L	1440	590	520	360	315	1750	600/300/170	700/90
UZD 14-28	1300	705	520	420	375	1900	600/400/170	700/90
AZD 36-40	1320	750	520	440	395	2050	600/400/170	700/90
ZD 800 A	1500	955	420	495	450	2450	ø 600/170	700/90
ZD 800 B	1360	1065	540	560	515	3000	ø 600/170	700/90
ZD 800 A-weld <sup>1)</sup>	1510	702	400	420	375	1500	600/400/120	500/90
ZD 800 B-weld <sup>1)</sup>	1400	738	430	438	393	1650	600/400/120	500/90
HS 8 -11	720	1270	430	710	665	1250	ø 600/170	500/90
HD 6 -11	840	1410	470	770	725	2350	ø 600/170	700/90

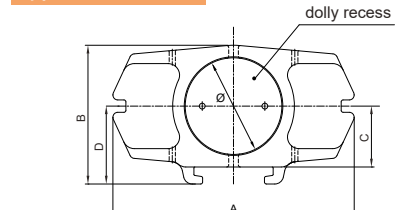
<sup>1)</sup> Availability and product details to be checked with technical department.

<sup>2)</sup> Refers to Type 2 drawing.

### Type 1

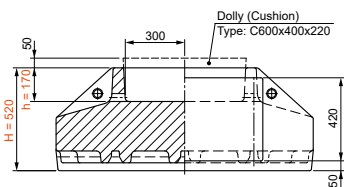


### Type 2

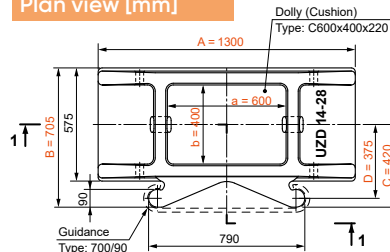


## Driving caps - Examples

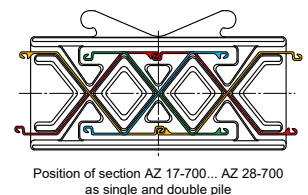
### Section 1-1 (UZD 14-28) [mm]



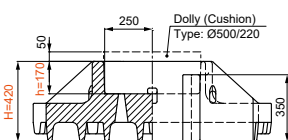
### Plan view [mm]



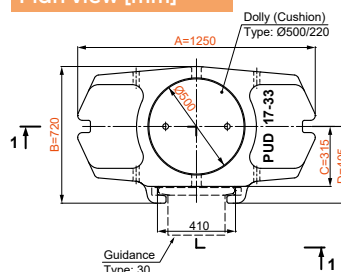
### Bottom view



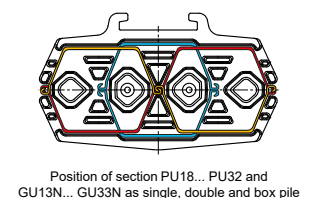
### Section 1-1 (PUD 17-33) [mm]



### Plan view [mm]



### Bottom view



## Sheet pile sections and corresponding driving caps

Arrangement	Driving caps							S	D/B	D/B	S	S	D/T/B	D/T/B	D/B	S	D		
	Sections	AZD 12-14	AZD 12-14-L	UZD 14-28	AZD 36-40	A 18/26	ZD 800 A											ZD 800 B	AUS 14-26
<b>AZ<sup>®</sup>-800</b>																			
AZ 18-800																		✓	
AZ 20-800																		✓	
AZ 22-800																		✓	
AZ 23-800																		✓	✓
AZ 25-800																		✓	✓
AZ 27-800																		✓	✓
<b>AZ<sup>®</sup>-750</b>																			
AZ 28-750																			✓
AZ 30-750																			✓
AZ 32-750																			✓
<b>AZ<sup>®</sup>-700 and AZ<sup>®</sup>-770</b>																			
AZ 12-770			✓																
AZ 13-770			✓																
AZ 14-770			✓																
AZ 14-770-10/10			✓																
AZ 12-700		✓																	
AZ 13-700		✓																	
AZ 13-700-10/10		✓																	
AZ 14-700		✓																	
AZ 17-700				✓															
AZ 18-700				✓															
AZ 19-700				✓															
AZ 20-700				✓															
AZ 24-700				✓															
AZ 26-700				✓															
AZ 28-700				✓															
AZ 36-700N					✓														
AZ 38-700N					✓														
AZ 40-700N					✓														
AZ 42-700N					✓														
AZ 44-700N					✓														
AZ 46-700N					✓														
AZ 48-700					✓														
AZ 50-700					✓														
AZ 52-700					✓														
<b>AZ<sup>®</sup></b>																			
AZ 18						✓													
AZ 18-10/10						✓													
AZ 26						✓													
<b>AU<sup>TM</sup></b>																			
AU 14								✓	✓										
AU 16								✓	✓										
AU 18								✓		✓									
AU 20								✓		✓									
AU 23								✓		✓									
AU 25								✓		✓		✓							
<b>PU<sup>®</sup></b>																			
PU 12											✓	✓	✓						
PU 12S											✓	✓	✓						
PU 18 <sup>-1</sup>											✓			✓	✓				
PU 18											✓			✓	✓				
PU 18 <sup>+1</sup>											✓			✓	✓				
PU 22 <sup>-1</sup>											✓			✓	✓				
PU 22											✓			✓	✓				
PU 22 <sup>+1</sup>											✓			✓	✓				
PU 28 <sup>-1</sup>											✓	✓		✓					
PU 28											✓	✓		✓					
PU 28 <sup>+1</sup>											✓	✓		✓					
PU 32 <sup>-1</sup>											✓	✓		✓	✓				
PU 32											✓	✓		✓	✓				
PU 32 <sup>+1</sup>											✓	✓		✓	✓				
<b>GU<sup>®</sup></b>																			
GU 6N											✓	✓	✓ <sup>1)</sup>						
GU 7N											✓	✓	✓ <sup>1)</sup>						
GU 7S											✓	✓	✓ <sup>1)</sup>						
GU 7HWS											✓	✓	✓ <sup>1)</sup>						
GU 8N											✓	✓	✓ <sup>1)</sup>						
GU 8S											✓	✓	✓ <sup>1)</sup>						
GU 10N													✓						
GU 11N													✓						
GU 12N													✓						
GU 13N											✓			✓	✓				
GU 14N											✓			✓	✓				
GU 15N											✓			✓	✓				
GU 16N											✓			✓	✓				
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GU 27N											✓			✓					
GU 28N											✓			✓					
GU 30N											✓			✓	✓				
GU 31N											✓	✓		✓	✓				
GU 32N											✓	✓		✓	✓				
GU 33N											✓	✓		✓	✓				
<b>HZ<sup>®</sup>-M</b>																			
HZ 630M																		✓ <sup>2)</sup>	✓ <sup>2)</sup>
HZ 880M																		✓	✓
HZ 1080M																		✓	✓
HZ 1180M																		✓	✓

<sup>1)</sup> Not fitting for box piles.


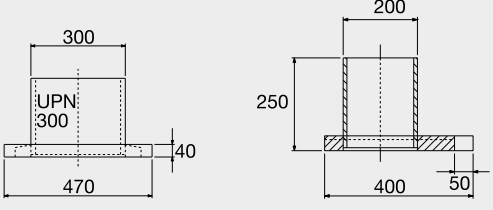
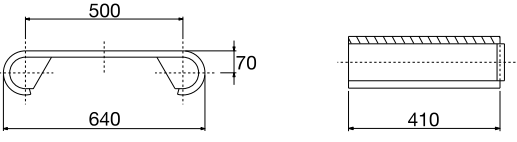
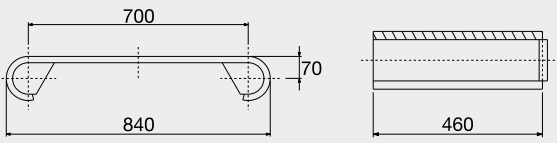
<sup>2)</sup> On request.

S = Single pile  
D = Double pile  
T = Triple pile  
B = Box pile

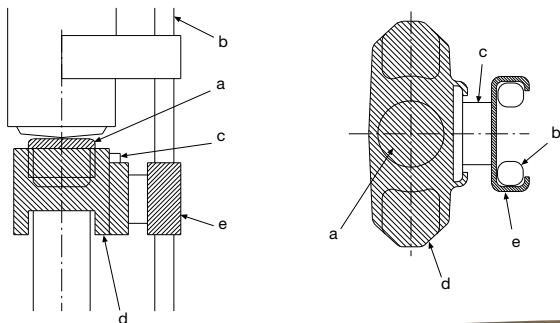


## Sliding guides

Sliding guides are designed to guide the driving cap along the leader, thus guaranteeing proper alignment of the hammer in the centre of the driving cap. Their adaptation to the leader is normally carried out on-site.

Dimensions	Designation	Corresponding driving caps
	330/50	PUS US-B
	30	UD PUD
	500/90	A AUS ZD 800 A-weld ZD 800 B-weld HS 8-11
	700/90	AUD AZD ZD 800 A ZD 800 B UZD HD 6-11

## Arrangement of driving caps



- a = dolly/cushion
- b = leader
- c = sliding guide
- d = driving cap
- e = leader slide

The leader slide (e) is not provided by ArcelorMittal.



# HP piles

HP piles are special H-shaped bearing piles with webs and flanges of the same thickness. They are used as bearing piles for foundation projects such as bridges and industrial facilities or as anchoring piles for quay or excavation walls.

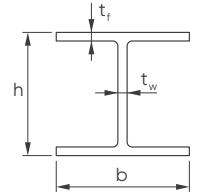
HP piles have the following common characteristics:

- guaranteed pile integrity after installation.
- No length limitations due to trimming or splicing;
- easy to store, handle and install.
- Easy connection to superstructure;

HP bearing piles range from HP 200 to HP 400. They are available in structural steel grades (yield strength 235 – 355 MPa) as well as in high-strength steel grades (yield strength 355 – 460 MPa), including HISTAR® quality.

Rolling tolerances on dimensions, shape, weight and length are fixed in accordance with EN 10034.

- bearing capacity available right after installation, capacity can be determined during installation;
- excellent durability. Corrosion rates of embedded HP piles are extremely low;
- HP piles are able to take high tensile and bending forces.



Minimum delivery length is 8 m, maximum delivery length is 24.1 m for HP 200/220/260 and 33.0 m for HP 305/320/360/400.

The table below shows a selection of available piles. **Please refer to the brochure “Wide flange bearing piles” for detailed information on the entire HP range.**

Section	Mass kg/m	Dimensions				Sectional area cm <sup>2</sup>	Total area A <sub>tot</sub> = h · b cm <sup>2</sup>	Perimeter m	Moment of inertia		Elastic section modulus	
		h	b	t <sub>w</sub>	t <sub>f</sub>				y-y	z-z	y-y	z-z
		mm	mm	mm	mm				cm <sup>4</sup>	cm <sup>4</sup>	cm <sup>3</sup>	cm <sup>3</sup>
HP 200 x 43	42.5	200	205	9.0	9.0	54.1	410	1.18	3888	1294	389	126
HP 220 x 57	57.2	210	225	11.0	11.0	72.9	472	1.27	5729	2079	546	185
HP 260 x 75	75.0	249	265	12.0	12.0	95.5	660	1.49	10650	3733	855	282
HP 305 x 110	110	308	311	15.3	15.4	140	955	1.80	23560	7709	1531	496
HP 320 x 117	117	311	308	16.0	16.0	150	958	1.78	25480	7815	1638	508
HP 360 x 152	152	356	376	17.8	17.9	194	1338	2.15	43970	15880	2468	845
HP 400 x 213	213	368	400	24.0	24.0	271	1472	2.26	63920	25640	3474	1282

t<sub>w</sub> = t<sub>web</sub> = web thickness      t<sub>f</sub> = t<sub>flange</sub> = flange thickness



# Durability of steel sheet piles

Unprotected steel in the atmosphere, water or soil is subject to corrosion that may lead to damage. Local weakening and rusting-through are normally considered to be maintenance problems that can be remedied locally.

Depending on life-time requirements and accessibility to the structure, the service life of a steel structure can be achieved by one or a combination of following methods:

- protection by coating (typically only in high corrosion zones);
- use of a stronger section or a higher steel grade to create a “structural design reserve”;

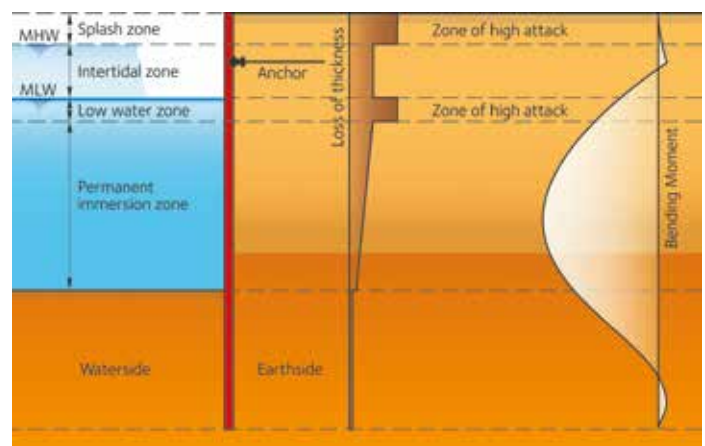
- use of Marine Grade Steel ASTM A690 (splash zone);
- avoiding important bending moments in the high corrosion zones;
- extension of the concrete capping beam below the low-water level;
- cathodic protection by impressed current or by sacrificial anodes (protects the surface constantly in contact with water);
- use of AMLoCor® steel grade (permanent immersion zone and low water zone).

## Corrosion rates



The maximum steel stress in most maritime sheet pile structures is situated within the permanent immersion zone. The loss of thickness in this zone is considerably lower than in the high corrosion zones. Steel stress is generally very low in the maximum corrosion zones: splash zone & low water zone. These locations are therefore not the critical part of the structure despite their negative appearance if unprotected.

Typical loss of thickness due to corrosion and moment distribution for anchored sheet pile wall in marine environment:



Please refer to EC 3 Part 5 (EN 1993-5) for details on loss of steel thickness as a result of exposure in different media.

The use of the steel grade AMLoCor® significantly increases the design life of marine structures.

## Surface coating

The classical corrosion protection for steel sheet piling is surface coating. EN ISO 12944 deals with protection by paint systems and its various parts cover all the features that are important in achieving adequate corrosion protection. It is essential that the steel surface is properly prepared before applying a coating system: removal of millscale by abrasive blasting (cf. ISO 8501-1). Most systems consist of one or two primers, an intermediate coat and a topcoat. Zinc primers are used frequently due to their good corrosion-inhibiting properties.

Intermediate coats increase the total thickness and thus increase the distance for moisture diffusion to the surface. Topcoats are chosen for colour and gloss retention, for chemical resistance, or for additional resistance to mechanical damage. Epoxies are generally used for seawater immersion and chemical resistance, polyurethanes for colour and gloss retention. Below, paint systems are proposed for different environments according to classifications of EN ISO 12944.



Metro Copenhagen, Denmark

## Atmospheric exposure

Some applications require a stronger aesthetic component, where the steel sheet pile wall appearance is very relevant. In those cases, polyurethane finishes - which are easy to apply and maintain - are the preferred choice, mainly due to their good gloss and colour retention characteristics.

**Proposal (EN ISO 12944 – Table A4, corrosivity category C4):**

Epoxy primer  
Recoatable epoxy intermediate coating  
Aliphatic polyurethane topcoat  
Nominal dry-film thickness of the system: 240 µm



Flood protection wall, Hamburg, Germany

## Sea water & fresh water immersion Im1 / Im2

For long-term performance of steel structures immersed in sea water and in fresh water there should be no compromise on quality of the coating system, particularly as it may be damaged due to abrasion and impact. The application must be properly carried out and inspected on a regular basis. Cathodic protection is sometimes specified in combination with a (fully compatible) coating system.

### Proposal (EN ISO 12944 – Table A6, corrosivity category Im2)

Epoxy primer  
Solvent-free epoxy coating or epoxy glass flake  
Nominal dry-film thickness of the system: 500–550  $\mu\text{m}$



Lock, Venice, Italy

## Landfills and contaminated soils

Excellent protection is essential due to exposure to highly aggressive substances. The coating system must have outstanding resistance to mineral and organic acids and other chemicals as well as capacity to withstand abrasion and impacts.

### Proposal

Micaceous iron oxide pigmented polyamide cured epoxy primer  
Polyamide-cured-epoxy coating with increased chemical resistance  
Nominal dry-film thickness of the system: 480  $\mu\text{m}$



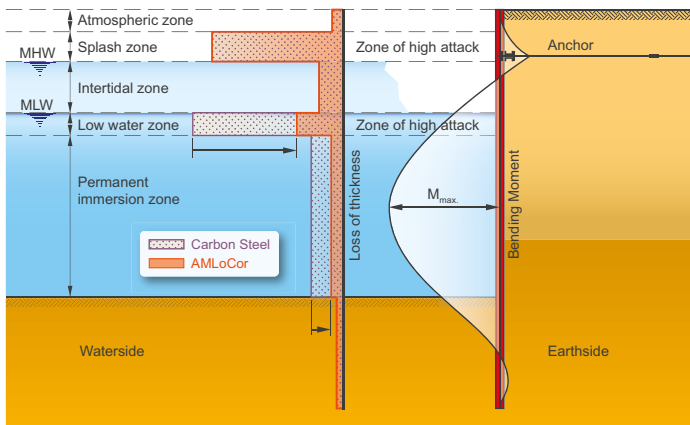
Waste disposal, Horn, Austria

# AMLoCor®

Corrosion resistant steel grade for marine applications

AMLoCor® is ArcelorMittal’s “low corrosion” steel grade that will revolutionize the design of port structures in the future.

The key advantage of AMLoCor® is a significant reduction of the corrosion rates in the “Low Water Zone” (LWZ) and in the “Permanent Immersion Zone” (PIZ), which is normally the location of the maximum bending moments and consequently highest steel stresses. This steel grade is the solution to address the major concern of designers and port authorities: **durability of marine structures** like quay walls, breakwaters and jetties.

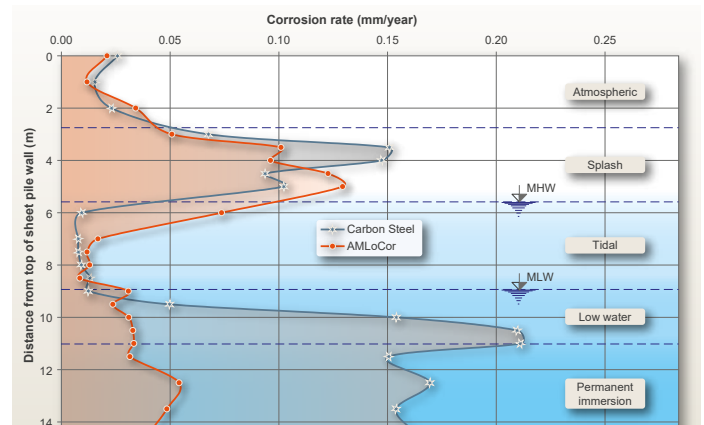


Typical loss of steel thickness in a marine environment regular carbon steel vs. AMLoCor®.

Eurocode 3 Part 5 contains reference tables with typical corrosion rates valid for standard carbon steel in northern European countries. In-situ tests have proven that the **loss of steel thickness of AMLoCor is reduced by a factor 3 (PIZ) to 5 (LWZ) compared to standard structural steel** in the critical zones.

**AMLoCor leads to considerable savings in steel weight** compared to the unprotected carbon steel piling solution, as soon as loss of steel thickness due to corrosion in the immersion zone is significant. Cathodic protection or coatings can be used to increase the service life of the sheet pile structure. However, **AMLoCor® will in many cases yield the most cost-effective solution in the long-term**. AMLoCor is compatible with cathodic protection and coatings.

In addition AMLoCor protects the structures from “ALWC” (Accelerated Low Water Corrosion) which is related to biological activity enhancing degradation of steel in the low water zone.



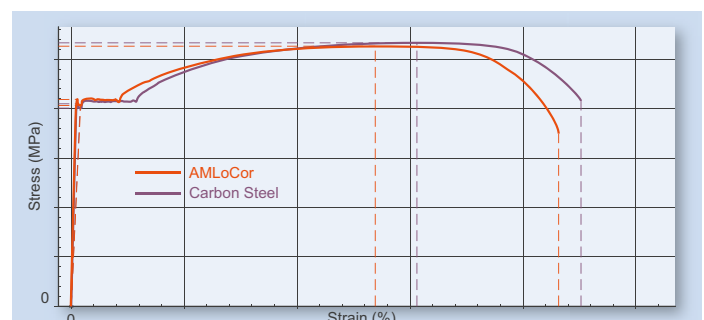
Steel grades AMLoCor are covered by the German National Technical Approval Z-30.10-55 of the “Deutscher Institut für Bautechnik (DIBt)”.

The mechanical properties of AMLoCor steel are fully equivalent to standard piling grades, so that structural resistance can be determined according to all relevant design codes used for steel sheet piling structures, like EN 1993-5:2007 in European countries.

Some AZ sections are already available in AMLoCor steel grades, ranging from **AMLoCor Blue 320 to Blue 390** (yield strength 320 MPa up to 390 MPa). Please check our website for regular updates on available sections.

A driving test was performed in very compact soil in Denmark. Sheet piles in S 355 GP and AMLoCor Blue 355 were driven into very hard soils with some boulders. The sheet piles were monitored during driving, then pulled out and inspected. This test has demonstrated that the behaviour of AMLoCor sheet piles is equivalent to regular carbon steel sheet piles.

For more detailed information (e.g. on welding) please check our **brochure “AMLoCor®”**.



Typical Stress – Strain diagram of carbon steel & AMLoCor®.

# Watertightness

Steel sheet piles are completely impervious. The only possibility of water infiltrating through a sheet pile wall is by penetration through the interlock. Due to its shape, the Larssen interlock naturally provides high seepage resistance.

Sealing systems are therefore not necessary for applications such as temporary retaining walls where moderate rates of

seepage are acceptable. If medium to high seepage resistance is required, e.g. cut-off walls for contaminated sites, retaining structures for bridge abutments or tunnels, double sheet piles with sealed or welded joints are recommended.

**Please refer to our brochure "The impervious sheet pile walls" for further details.**

The following sealing systems are used to increase the watertightness of sheet pile walls:

- bituminous filler: **Beltan® Plus**,  
maximal water pressure: 100 kPa;
- wax & mineral-oil-based filler: **Arcoseal™**,  
maximal water pressure: 100 kPa;
- water-swelling product: **ROXAN® Plus System**,  
maximal water pressure: 200 kPa;
- **AKILA® System**,  
maximal water pressure: 300 kPa;
- welding: 100% watertight.

As Darcy's law for discharge through homogenous structures is not applicable to leakage phenomenon through sheet pile interlocks, a new concept of "joint resistance" has been developed by GeoDelft (Deltares).

$$q(z) = \rho \cdot \Delta p(z) / \gamma_w$$

$q(z)$	water discharge [m <sup>3</sup> /s/m]
$\rho$	inverse joint resistance [m/s]
$\Delta p(z)$	pressure drop at level z [kPa]
$\gamma_w$	unit weight of water [kN/m <sup>3</sup> ]

Sealing system/method	$\rho$ [10 <sup>-10</sup> m/s]			Application of the system	Cost ratio <sup>1)</sup>
	100 kPa	200 kPa	300 kPa		
No sealant	> 1000	–	–	–	0
Beltan® Plus	< 600	not recommended	–	easy	1.0
Arcoseal™	< 600	not recommended	–	easy	1.2
ROXAN® Plus	0.5	0.5	–	with care	1.8
AKILA®	0.3	0.3	0.5	with care	2.1
Welded interlocks	0	0	0	2)	5.0

<sup>1)</sup> Cost ratio =  $\frac{\text{Cost of sealing system}}{\text{Cost of Beltan® Plus Solution}}$

<sup>2)</sup> After excavation for the interlock to be threaded on jobsite.



# AKILA<sup>®</sup> sealing system

AKILA<sup>®</sup> is an **environment-friendly high performance sealing system** for ArcelorMittal steel sheet piles. The system is based on three sealing "lips" mechanically extruded into the free interlocks using a product called MSP-1. The common interlock of double piles is sealed with a second product called MSP-2.

MSP-1 and MSP-2 belong to the family of **silane modified polymers** (MS-Polymers). Both products are resistant to humidity and weathering.

Their main characteristics are:

- **single component elastic sealants** with a density of
  - 1.41 g/cm<sup>3</sup> for MSP-1;
  - 1.48 g/cm<sup>3</sup> for MSP-2;
- UV-stable;
- **excellent adhesion to steel**;
- resist to temperatures between -40°C and +90°C (up to 120°C for short periods);
- elongation at break > 380%;
- Shore A hardness after complete polymerization
  - 58 for MSP-1;
  - 44 for MSP-2 (after 14 days);
- durable in contact with freshwater, seawater as well as various hydrocarbons, bases and acids (depending on concentration – a complete list is available on request).

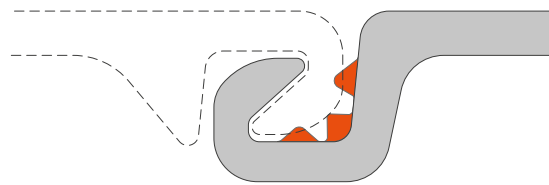
## Inverse joint resistance $\rho_m$

A series of in-situ tests were carried out in stiff clays and in soft sandy soils. Single and crimped double sheet piles, fitted out with the AKILA<sup>®</sup> system, were driven into the ground using an impact hammer as well as a vibratory hammer.

In case of vibrodriving, sheet piles were driven continuously at a minimum penetration rate of 3 meters per minute. After installation, watertightness was tested at **water pressures of 2 and 3 bar**, according to a procedure developed by Delft Geotechnics (Deltares) and ArcelorMittal. The testing and the results were witnessed and certified by "Germanischer Lloyd", an independent third party.

The average **inverse joint resistance  $\rho_m$**  was determined according to EN 12063, see table below.

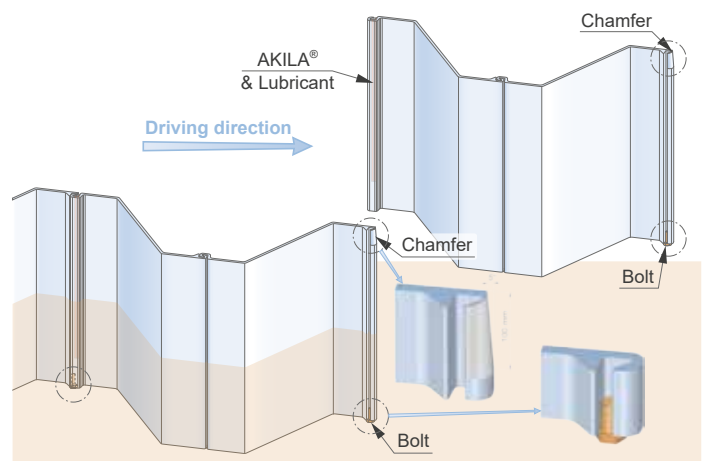
Water pressure	$\rho_m$ (m/s)	
	200 kPa	300 kPa
Single piles (MSP-1)	$4.9 \times 10^{-11}$	$8.6 \times 10^{-11}$
Double piles (MSP-1 & MSP-2)	$3.3 \times 10^{-11}$	$4.7 \times 10^{-11}$



Sketch of MSP-1 product extruded into the free interlock.

MS-Polymers are solvent free and do not contain isocyanates. They can be considered environment-friendly products. AKILA<sup>®</sup> is certified by the "Hygiene-Institut des Ruhrgebiets" in Germany as suitable for use in contact with groundwater.

The free interlocks have to be chamfered at the top (see sketch). Penetration of soil into the interlocks during driving should be prevented, for instance by inserting a bolt at the bottom of the interlock (bolt tack welded). The ambient temperature during installation must be above 0°C. Additionally, to improve the sliding of the interlocks, an environment-friendly lubricant must be applied to the sealant in the interlocks prior to driving. The layout and driving direction of the sheet pile wall shall be determined before ordering the sheet piles (delivery form of double piles, chamfering of interlocks, etc.).



Installation recommendations (driving direction, chamfer, etc.).

For more information contact our technical department.



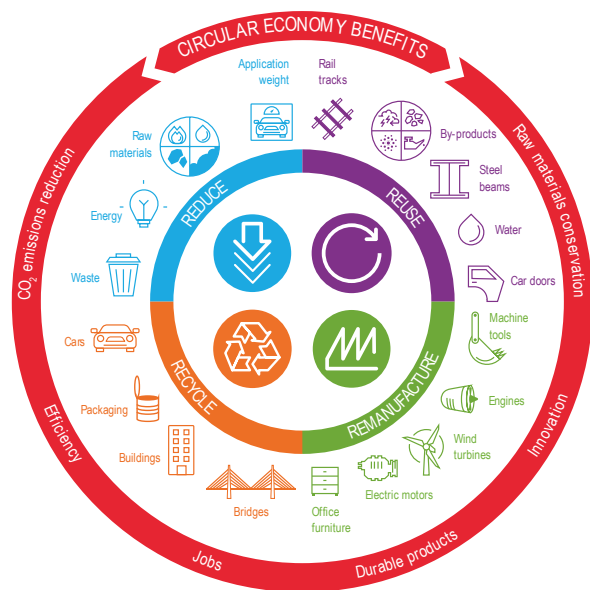
# Sustainability & Environmental Product Declaration (EPD)

ArcelorMittal champions steel's ability to create high quality, sustainable lifestyles for people all over the world. In 2010, it was the first steel manufacturer that performed a Life Cycle Assessment (LCA) dedicated to steel sheet piles.

ArcelorMittal's brand values are health & safety, sustainability, quality and leadership. As a global leading steel producer, we aim at reaching carbon neutrality by 2050.

Steel is one of the only materials to be completely reusable and recyclable. It will play a critical role in building the circular economy of the future. Steel will continue to evolve, becoming smarter, and increasingly sustainable.

## Circular economy



© World Steel Association (worldsteel)

ArcelorMittal's hot rolled and cold formed steel sheet piles are covered by several Environmental Product Declarations (EPD). Its first EPD was published in 2016.

ArcelorMittal Sheet Piling's goal is to provide cost-effective and sustainable foundation solutions that take into account society's expectations for the preservation of our planet. ArcelorMittal's steel sheet piles are an environmentally friendly construction product produced in European facilities that report transparent indicators of their environmental performance. They have certified health & safety, environmental, energy and quality management systems.

ArcelorMittal Sheet Piling is a major actor in the circular economy, promoting greater resource productivity, aiming to reduce waste and avoid pollution. This contrasts with a linear take-make-dispose economy, which wastes large amounts of resources, energy, and labour. One of the main objectives of circular economy is to reduce waste systematically throughout the different life cycles of a product. Circular economy refers usually to numerous R's: Reduce, Reuse, Remanufacture, Recycle,...

Steel is a permanent material: never consumed, but continuously transformed; the use of natural resources for producing steel the first time is therefore a transformative process, making iron available in a more "practical form" for subsequent uses (life cycles).

ArcelorMittal has been optimizing its sheet piles for more than 100 years to **reduce** the consumption of raw materials. For instance, using the latest AZ-800 range saves up to 10% of steel compared to an equivalent profile from the AZ-700 range. Additionally, steel sheet piles can be **reused** up to 10 times in temporary applications. Finally, 100% can be recovered and 100% can be **recycled**. 100% of the steel produced in our Luxembourgish mills is made out of steel scrap (recycling process).

## Quality management and certifications

Customer satisfaction is our main goal. Our mills are certified in accordance to international standards ISO 9001, ISO 14001, ISO 50001, ISO 45001 as well as ResponsibleSteel™.

This is essential to maintain the high quality of our products and to develop innovative solutions.

## ArcelorMittal's EcoSheetPile™ and EcoSheetPile™ Plus labels

The **EcoSheetPile™** label certifies that the steel sheet piles are produced from 100% of recycled steel. Launched in 2021, the **EcoSheetPile™ Plus** label certifies that the steel sheet piles are in addition produced from 100% certified renewable electricity, ensuring the lowest possible carbon footprint.

**EcoSheetPile™ Plus**

### Life Cycle Assessment (LCA)

Developed in the 1990's, the Life Cycle Assessment is a standardised methodology that analyses the environmental impacts of a product or a service during its production, use phase and end-of-life (ISO 14040). It is an important tool to the steel industry as a way to assess and quantify the environmental footprint of steel products along their entire

life cycle, from the sourcing of the natural resources, to its end-of-life and recycling phase. When performing an LCA it is also important to define the frame in which the assessment is made. An LCA can be used to compare the environmental impact of different solutions and/or products from different manufacturers.

### Environmental Product Declaration (EPD)

An EPD is a verified and registered document that communicates transparent data about the life cycle environmental impact of one or more products. It is usually developed by the manufacturer, peer reviewed by an independent verifier on the basis of ISO 14025 and EN 15804

standards, and published by an official EPD Program Holder. Thus, EPDs provide suitable and objective data that can be used in public procurement processes. An EPD is valid for a period of 5 years after publication.



## Steel sheet piles' EPDs

ArcelorMittal's sheet piles are covered by several EPDs registered at different program operators such as *EPD International*, in accordance with the European Standards.

ArcelorMittal analysed the full production process and performed a Life Cycle Assessment of its steel sheet piles.

ArcelorMittal's EPDs are generally of the type **"cradle-to-gate with options"**. They consider the different steps of the steel making process ("cradle to gate"), and additional "options".

The EPDs take into account the following boundary conditions:

- resources: provision of resources, additives and energy;
- transportation of resources and additives to the production site;
- steel making process analysis on site, including energy, production of additives, disposal and valorisation of production residues, and consideration of related emissions;
- waste processing (after-use);
- end-of-life scenarios: reuse and recycling.

Our EPDs contain the following modules:

- A1-A3: structural steel production;
- C3-C4: deconstruction, transport, sorting and shredding of after-use steel, non-recovered scrap due to sorting efficiency;
- D: End-of-Life scenarios, including reuse and recycling.

Due to national requirements, additional modules may be declared in some EPDs. All the data used in the LCA was collected through recommended templates developed by World Steel Association and its experts for Life Cycle Inventories (LCI) purpose.

The data of the different sites was cross-checked and compared to the previous years' data to identify potential inconsistencies. All the processes, materials and emissions that are known to make a significant contribution to the environmental impact were considered. It comprises used materials, thermal energy, electrical energy and fuel consumption as well as emissions from on-site measurements.

Steel sheet piles can be reused several times and recycled at the end of life. The assumption made in our EPDs for hot rolled sheet piles is that for each tonne produced, 25% will be reused. At least 60% of the steel sheet piles are recycled after the first use, and a varying proportion from 1 to 15% will be landfilled. The different assumptions are detailed in each specific EPD document.

Although the period in which the steel sheet piles are used in their different applications is not defined in the EPD, it is important to define their service life to highlight their durability as a construction material. Steel sheet piles can be designed for 50 years and more, and there are documented cases of sheet pile walls built in the early 20<sup>th</sup> century that are still in use.

ArcelorMittal Sheet Piling has published several EPDs since 2016. As the applicable standards and local regulations can change, please contact our sustainability department for more information on all available EPDs.

1. The generic **"Hot rolled steel sheet piling"** EPD was published in 2016 at IBU and covers hot rolled steel sheet piles (AZ<sup>®</sup>, AU<sup>™</sup>, PU<sup>®</sup>, GU<sup>®</sup>, AS 500<sup>®</sup> and HZ<sup>®</sup>-M) produced by ArcelorMittal in the plants of Belval (Luxembourg), Differdange (Luxembourg) and Dabrowa (Poland). It is based on a mix of the Electric Arc Furnace (EAF) route and on the blast furnace (BOF) route. It covers 100% of the annual production volumes of 2015.
2. The **"EcoSheetPile<sup>™</sup>"** EPD was published in 2018 at IBU and covers hot rolled steel sheet piles (AZ<sup>®</sup>, AU<sup>™</sup>, PU<sup>®</sup>, AS 500<sup>®</sup> and HZ<sup>®</sup>-M) produced by ArcelorMittal in the plants of Belval (Luxembourg) and Differdange (Luxembourg). It is based on the Electric Arc Furnace (EAF) route: 100% of recycled material. The data refers to the production volumes of 2015.
3. The **"Cold formed steel sheet piles"** EPD published in 2019 at IBU covers cold formed steel sheet piles (PAZ<sup>™</sup>, PAL<sup>™</sup>, PAU<sup>™</sup> and trench sheets) manufactured by ArcelorMittal in its plant in Messempré (France). It uses data collected from the steel shops producing the coils (Dunkerque in France, Ostrava in the Czech Republic). It is based on the blast furnace (BOF) route. Data collected from the cold forming mill is also considered. The data refers to the production volumes of 2017.
4. The **"EcoSheetPile<sup>™</sup> Plus"** EPD was published in 2021 at IBU and covers hot rolled steel sheet piles (AZ<sup>®</sup>, AU<sup>™</sup>, PU<sup>®</sup>, AS 500<sup>®</sup> and HZ<sup>®</sup>-M) produced by ArcelorMittal in the plants of Belval and Differdange (Luxembourg). It is based on the Electric Arc Furnace (EAF) route with 100% recycled material and **100% renewable electricity supply**. The data refers to the production volumes of 2019.
5. The **"EcoSheetPile<sup>™</sup> Plus - Steel Sheet Piles"** EPD was published in 2023 at EPD International and covers hot rolled steel sheet piles (AZ<sup>®</sup>, AU<sup>™</sup>, PU<sup>®</sup>, AS 500<sup>®</sup> and HZ<sup>®</sup>-M) produced by ArcelorMittal in the plants of Belval and Differdange (Luxembourg). It is based on the Electric Arc Furnace (EAF) route with **100% recycled material and 100% renewable electricity supply**. The data refers to the production volumes of 2021.

**Note:** a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to EN 15804 and if the building context, respectively the product-specific characteristics of performance, are taken into account. The fairest and most objective method to compare different alternatives is to perform an LCA based on the data provided in the EPD of the manufacturer of the product.

# Delivery conditions

## Tolerances on shape and dimensions of hot rolled steel sheet piles according to EN 10248-2:1995 (reduced tolerances on request)

Tolerances	AZ <sup>®</sup>	AU <sup>™</sup> , PU <sup>®</sup> , GU <sup>®</sup>	AS 500 <sup>®</sup>	HZ <sup>®</sup> -M
Mass <sup>1)</sup>	± 5%	± 5%	± 5%	± 5%
Length (L)	± 200 mm	± 200 mm	± 200 mm	± 200 mm
Height (h) <sup>2)</sup>	h ≥ 300 mm: ± 7 mm	h ≤ 200 mm: ± 4 mm h > 200 mm: ± 5 mm	-	h ≥ 500 mm: ± 7 mm
Thicknesses (t <sub>r</sub> , t <sub>w</sub> )	t <sub>r</sub> , t <sub>w</sub> ≤ 8.5 mm: ± 0.5 mm t <sub>r</sub> , t <sub>w</sub> > 8.5 mm: ± 6%	t <sub>r</sub> , t <sub>w</sub> ≤ 8.5 mm: ± 0.5 mm t <sub>r</sub> , t <sub>w</sub> > 8.5 mm: ± 6%	t <sub>w</sub> > 8.5 mm: ± 6%	t <sub>r</sub> , t <sub>w</sub> > 12.5 mm: -1.5 mm/+2.5 mm
Width single pile (b,w)	± 2% b	± 2% b	± 2% b	± 2% w
Width double pile (2b)	± 3% (2b)	± 3% (2b)	± 3% (2b)	-
Straightness (q)	≤ 0.2% L	≤ 0.2% L	≤ 0.2% L	≤ 0.2% L
Ends out of square	± 2% b	± 2% b	± 2% b	± 2% w

<sup>1)</sup> From the mass of the total delivery.

<sup>2)</sup> Of single pile.

## Maximum rolling lengths (longer sections available on request)

Section	AZ	AU, PU	GU <sup>®</sup>	AS 500	HZ-M	RH / RZ	OMEGA 18	C9 / C14	DELTA 13
Length [m]	31	31	28	31	33	24	16	18	17

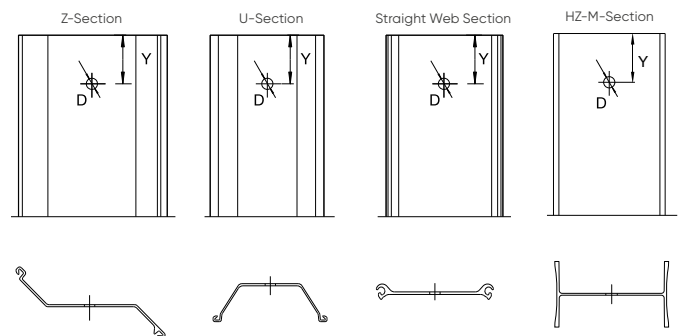
<sup>1)</sup> Contact us for detailed information.

## Handling holes

Sheet pile sections are normally supplied without handling holes. If requested, they can be provided with handling holes in the centreline of the section. The standard handling hole dimensions are as follows:

Diameter D [mm]	40	40	40	50	50	60 <sup>2)</sup>	63.5
Distance Y [mm]	75	150	300	200	250	230	230

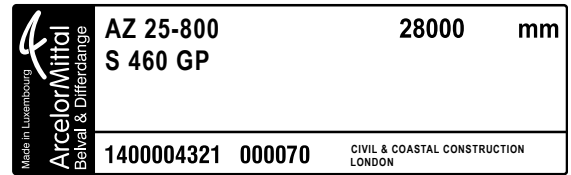
<sup>2)</sup> GU profiles have a standard hole diameter of 60 mm.



## Markings

The following markings can be supplied on request:

- colour marks defining section, length and steel grade;
- adhesive stickers showing the customer's name, destination, order and item number, type and length of profile and steel grade.



## Steel grades of sheet pile sections

Steel grade EN 10248-1:2023	Min. yield strength $R_{eH}$	Min. tensile strength $R_m$	Min. elongation $L_0=5.65\sqrt{S_0}$	Chemical composition <sup>1)</sup>						
				C	Mn	Si	P	S	N <sup>2)</sup>	CEV
	MPa	MPa	%	(% max.)						
S 240 GP	240	340	26	0.19	1.50	–	0.050	0.050	0.014	0,38
S 270 GP	270	410	24	0.20	1.60	–	0.050	0.050	0.014	0,43
S 320 GP	320	440	23	0.22	1.70	0.60	0.045	0.045	0.014	0,50
S 355 GP	355	480	22	0.22	1.70	0.60	0.045	0.045	0.014	0,50
S 390 GP	390	490	20	0.22	1.80	0.60	0.045	0.045	0.014	0,52
S 430 GP	430	510	19	0.22	1.80	0.60	0.045	0.045	0.014	0,52
S 460 GP	460	530	17	0.22	1.80	0.60	0.045	0.045	0.014	0,52
S 500 GP	500	580	15	0.22	1.80	0.60	0.045	0.045	0.014	0,52

AMLoCor <sup>®</sup>	Min. yield strength $R_{eH}$	Min. tensile strength $R_m$	Min. elongation $L_0=5.65\sqrt{S_0}$	Chemical composition <sup>1)</sup> (% weight)							
				C	Mn	Si	P	S	N <sup>2)</sup>	Cr	Al
	MPa	MPa	%	(% max.)						(% min.)	
Blue 320	320	440	23	0.27	1.70	0.60	0.05	0.05	0.011	0.75	0.40
Blue 355	355	480	22	0.27	1.70	0.60	0.05	0.05	0.011	0.75	0.40
Blue 390	390	490	20	0.27	1.70	0.60	0.05	0.05	0.011	0.75	0.40

<sup>1)</sup> Product analysis.

<sup>2)</sup> The maximum value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0,015 % or alternatively min. 0,013 % acid soluble Al or if sufficient other N binding elements are present. In this case the N binding elements shall be mentioned in the inspection document.

All the sections can be delivered in steel grades according to EN 10248-1:2023, but not all sections are available in all steel grades. The table on the following page summarizes the current possibilities.

Special steel grades such as **S 460 GP**, American **ASTM A 572** steel grades, steels with improved corrosion resistance like **AMLoCor** and **ASTM A 690**, or steels with copper addition in accordance with EN 10248-Part 1:2023, paragraph 7.2.4 and Option 3 in Chapter 13, can be supplied on request. A modified steel grade A 690 with higher yield strength is also available upon request.

Please contact us for information.

Galvanisation has an influence on the required chemical composition of the steel and must therefore be specified in the purchase orders.

We strongly recommend informing us of all surface treatments to be applied to the product when placing orders.

ArcelorMittal can also provide steel grades complying with other standards (see table below).

Europe	EN 10248-1:2023	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 GP
USA	ASTM	A 328	-	A 572 Gr. 50; A 690	A 572 Gr. 55	A 572 Gr. 60	A 572 Gr. 65
Canada	CSA	Gr. 260 W	Gr. 300 W	Gr. 350 W	Gr. 400 W	-	-
Japan	JIS	SY 295	-	-	SY 390	-	-

Section	Steel grade	EN 10248-1:2023							ASTM		AMLoCor®			
		S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 GP	S 500 GP	A 572	A 690	Blue 320	Blue 355	Blue 390
AZ-700 to 800		✓ <sup>1)</sup>	✓	✓	✓	✓	✓	✓	❖	✓	✓			
AZ		✓ <sup>1)</sup>	✓	✓	✓	✓	✓	✓	❖	✓	✓ <sup>1)</sup>			
AU		✓ <sup>1)</sup>	✓	✓	✓	✓	✓	✓	❖	✓	✓			
PU		✓ <sup>1),2)</sup>	✓ <sup>2)</sup>	✓ <sup>2)</sup>	✓	✓	✓ <sup>3)</sup>	✓ <sup>3)</sup>	❖	✓	✓ <sup>3)</sup>			
GU-N/S		✓ <sup>1)</sup>	✓	✓	✓	✓	✓	✓ <sup>4)</sup>	✗	❖	✗			
GU-400		✓ <sup>1)</sup>	✓	✓	✓	✓	❖	❖	✗	❖	✗			
HZ-M		✓ <sup>1)</sup>	✓	✓	✓	✓	✓	✓	❖	✓	✓			
RH / RZD / RZU		✗	✗	✗	✗	✗	✓	✓	❖	✗	✓			
C 9		✗	✗	✗	✓	✗	✗	✗	✗	✓	✗			
C 14		✗	✗	✗	✓	✗	✗	✗	✗	✗	✗			
Delta 13		✗	✗	✗	✓	✗	✗	✗	✗	✗	✗			
Omega 18		✗	✗	✗	✗	✗	✓	✓	✗	✗	✗			
AZ 30-750												✓	✓	✗
AZ 20-800												✓	✓	✓
AZ 19-700												✓	✓	✓
AZ 20-700												✓	✓	✓
AZ 26-700												✓	✓	✓
AZ 28-700												✓	✓	✓
AZ 38-700N												✓	✓	✗
AZ 40-700N												✓	✓	✗
AZ 44-700N												✓	✓	✗
AZ 46-700N												✓	✓	✗
AZ 26												✓	✓	✓
AZ 28												✓	✓	✗
C 9												✗	✓	✗

<sup>1)</sup> Please contact us as some limitations may apply.  
<sup>2)</sup> Except PU 12 & derivatives.  
<sup>3)</sup> PU 12 & derivatives on request.  
<sup>4)</sup> GU 11N & derivatives on request.

✓ Available  
 ❖ On request  
 ✗ Currently unavailable

## Geometric tolerances of tubular piles

Tolerance on pile length: ± 200 mm.

Standard	Outside diameter <i>D</i>	Wall thickness <i>t</i>	Straightness	Out-of-roundness	Mass	Maximum weld bead height <sup>5)</sup>
EN 10219-2	± 1% ± 10.0	± 10% ± 2.0	0.20% of total length	± 2%	± 6%	t ≤ 14.2: 3.5 t > 14.2: 4.8

<sup>5)</sup> Tolerance on height of internal and external weld bead for submerged arc-welded hollow sections.

Note: values in "mm" except where specified.

## Steel grades of tubular piles

Steel grade EN 10219-1	Min. yield strength $R_{eH}$ ( $t \leq 16$ mm)	Min. yield strength $R_{eH}$ ( $16 < t \leq 40$ mm)	Min. tensile strength $R_m$ ( $3 \leq t \leq 40$ mm)	Min. elongation $L_0$ ( $t \leq 40$ mm)	Chemical composition						
	MPa	MPa	MPa	%	C	Mn	P	S	Si	N	CEV ( $t \leq 20$ mm)
S 235 JRH	235	225	340-470	24	0.17	1.40	0.040	0.040	-	0.009	0.35
S 275 J0H	275	265	410-560	20	0.20	1.50	0.035	0.035	-	0.009	0.40
S 355 J0H	355	345	490-630	20	0.22	1.60	0.035	0.035	0.55	0.009	0.45
S 420 MH	420	400	500-660	19	0.16	1.70	0.035	0.030	0.50	0.020	0.43
S 460 MH	460	440	530-720	17	0.16	1.70	0.035	0.030	0.60	0.025	-

Steel grade API 5L, PSL 1 <sup>1)</sup> ISO 3183	Min. yield strength $R_{eH}$	Min. tensile strength $R_m$	Min. elongation <sup>2)</sup>	Chemical composition for tube with $t \leq 25.0$ mm <sup>4)</sup>			
	MPa	MPa	%	C <sup>3)</sup>	Mn <sup>3)</sup>	P	S
L 245 or B	245	415	23	0.26	1.20	0.030	0.030
L 290 or X 42	290	415	23	0.26	1.30	0.030	0.030
L 320 or X 46	320	435	22	0.26	1.40	0.030	0.030
L 360 or X 52	360	460	21	0.26	1.40	0.030	0.030
L 390 or X 56	390	490	19	0.26	1.40	0.030	0.030
L 415 or X 60	415	520	18	0.26 <sup>5)</sup>	1.40 <sup>5)</sup>	0.030	0.030
L 450 or X 65	450	535	18	0.26 <sup>5)</sup>	1.45 <sup>5)</sup>	0.030	0.030
L 485 or X 70	485	570	17	0.26 <sup>5)</sup>	1.65 <sup>5)</sup>	0.030	0.030

<sup>1)</sup> API 5L (2018): American Petroleum Institute. PSL 1 (Product Specification Level 1): Composition according to specification.

<sup>2)</sup> Minimum elongation: depends on tensile test piece cross-sectional area.

<sup>3)</sup> For each reduction of 0.01% below the specified max C concentration, an increase of 0.05% above the specified max Mn concentration is permissible, up to a max of 1.65% for grades L245/B to L360/X52, 1.75% for L390/X56 to L450/X65 and 2.00% for L485/X70.

<sup>4)</sup> 0.50% max for Cu, 0.50% max for Ni, 0.50% max for Cr, 0.15% max for Mb.

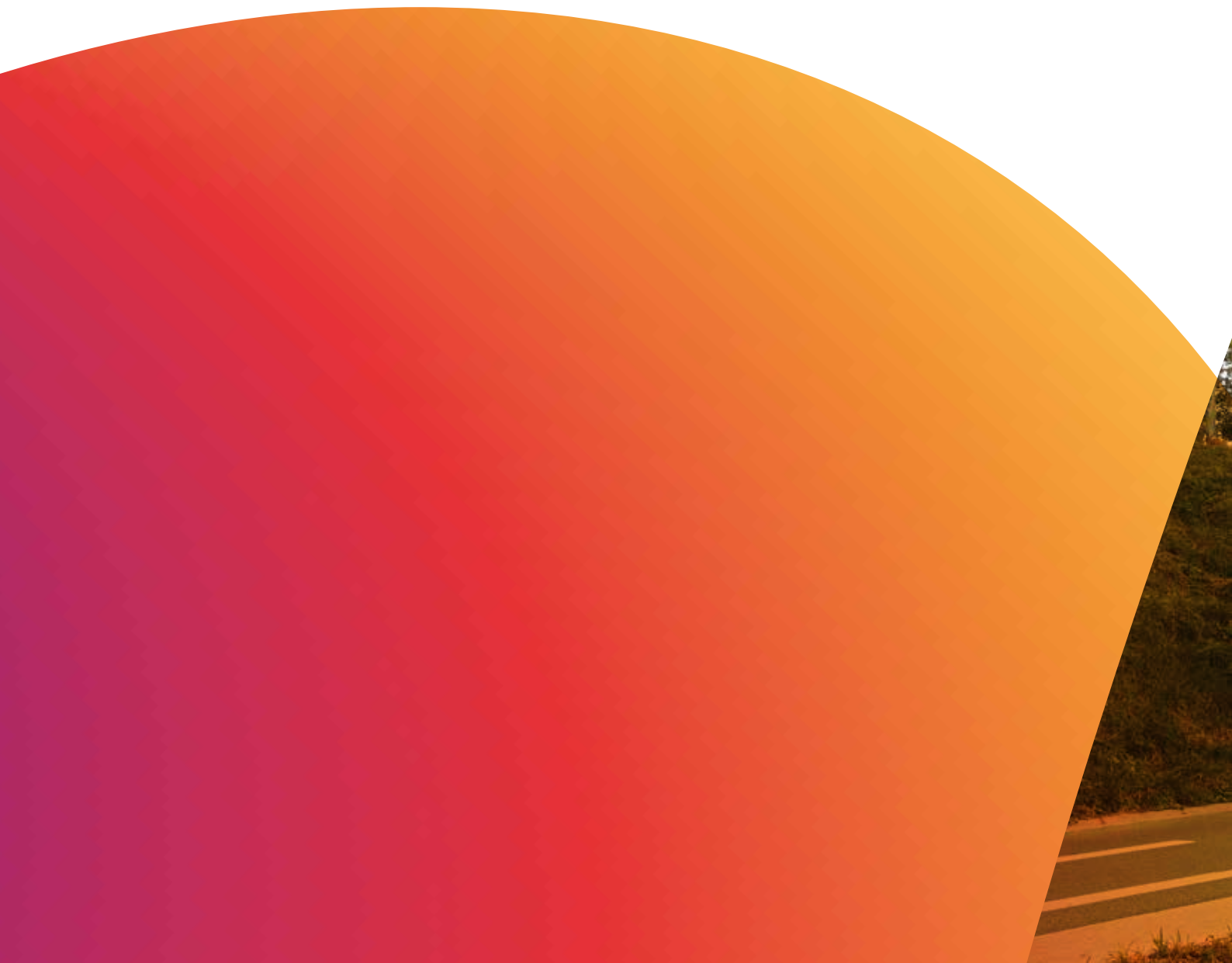
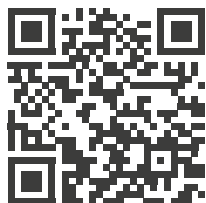
<sup>5)</sup> Unless otherwise agreed.



Tubular pile mill, Dintelmond, The Netherlands

# Documentation

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