ArcelorMittal Sheet Piling

ArcelorMittal

Steel Foundation Solutions

General Catalogue 2022 - Metric & Imperial edition

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

Ship lock on river Main at Eddersheim, Germany

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

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[*]. 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.

[*] Study by Karlsruher Institut für Technologie (KIT), Germany (2019).

[**] Study by Royal Haskoning DHV, the Netherlands (2019).

Efficient and reliable mobility infrastructures make your journey smoother and safer

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.

[*] 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

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

CERTIFICATE

The ESCEM asbl Certification Body hereby certifies that the company

ArcelorMittal Belval & Differdange S.A.

Site de Belval
L-4008 Esch-sur-Alzette

Site de Differdange
L-4503 Differdange

Site de Rodange
L-4823 Rodange

has established and applies a quality, environmental and occupational health and safety management system for the scope

Design and manufacture of steel semi and finished products (beams, sheet piles, merchant bars, rails, special sections, special round bars, completed elements, as well as completed structural elements)

An audit was performed, report No 112
Proof has been furnished that the requirements according to

ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018

are fulfilled.

The certificates are valid from 28.10.2019 until 27.10.2022

Certificates Registration No
900 112, 1400 112 et 4500 112

Esch-sur-Alzette, the 17.10.2019

ESCEM Asbl, 1 Avenue des Terres Rouges
L-4004 Esch-sur-Alzette

Certificate

Standard **ISO 50001:2018**

Certificate Registr. No. **01 407 125095/01**

Certificate Holder: **ArcelorMittal Belval & Differdange S.A.**
Site de Belval
Boulevard Charles de Gaulle
L-4008 Esch-sur-Alzette
Luxembourg

Scope: Design and manufacture of steel semi and finished products (beams, sheet piles and merchant bars)

Proof has been furnished by means of an audit that the requirements of ISO 50001:2018 are met.

Validity: The certificate is valid in conjunction with the main certificate from 2019-11-05 until 2022-11-04.

2019-10-17

TÜV Rheinland Cert GmbH
Am Grauen Stein · 51105 Köln

www.tuv.com

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Anyone making use of this material does so at his/her own risk. In no event will ArcelorMittal Commercial RPS S.à r.l. be held liable for any damages including lost profits, lost savings or other incidental or consequential damages arising from use of or inability to use the information contained within. Our sheet pile range is liable to change without notice.

Cover page:
Temporary steel sheet piles retaining wall for the construction of “De Entree” underground bicycle park
at the main train station in Amsterdam, the Netherlands.

Contents - Metric edition

New ferry pier built with HZ®-M combined wall, port of Calais, France

© Calais Port 2015

Introduction

ArcelorMittal is the largest steel and mining company in the world. ArcelorMittal is also the world's leading manufacturer of 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.

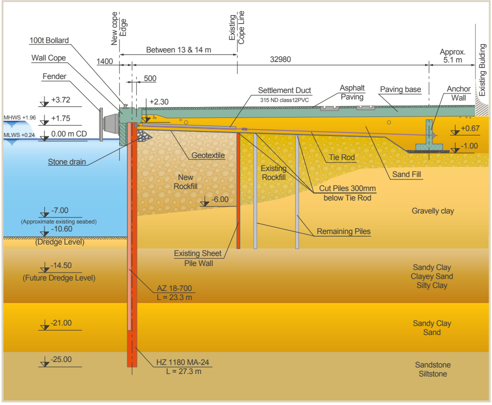
ArcelorMittal steel sheet piles are manufactured in Europe. Our values are sustainability, quality and leadership. We offer the most complete range of products and services, focused on bringing the most to our customers. ArcelorMittal Sheet Piling provides cost-competitive solutions and certified quality 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 it becomes essential for project owners to integrate green credentials assessment rules in their tendering processes, bids with a reduced carbon footprint have a tangible advantage over less environmentally friendly solutions.



Preliminary design for a quay wall

XCarb™
Recycled and renewably produced

EcoSheetPile™ Plus
100% Recycled
Reusable | Renewably produced
Recyclable

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.

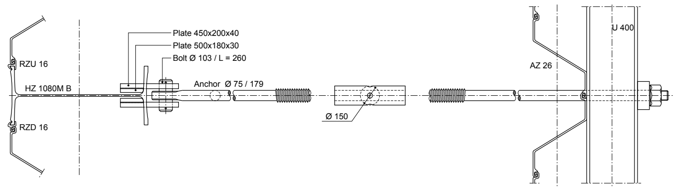
Our technical experts regularly teach at universities and design consulting offices. They also share their experience at geotechnical and specialised technical seminars throughout the world.

Customised solutions

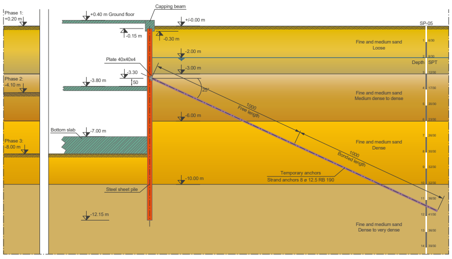
ArcelorMittal Sheet Piling provide customised products and solutions that best fit the project requirements. We design and manage special fabrications and ensure on-time delivery to the construction sites.

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 connections, interlocks and pile toe reinforcements, bore drainage or lifting holes.

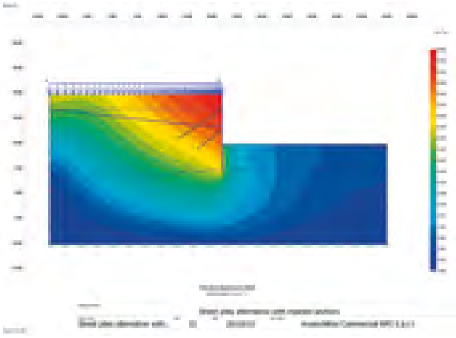
Our services also include coating for corrosion protection and aesthetics, from a selection of systems and colours including galvanisation and multi-layer painting. We can also apply interlock sealants on demand.



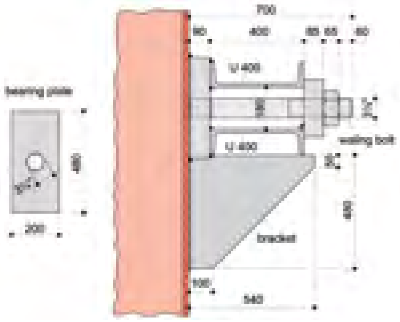
Complete solutions including sheet pile walls, anchors, corner layouts and special piles



Feasibility studies

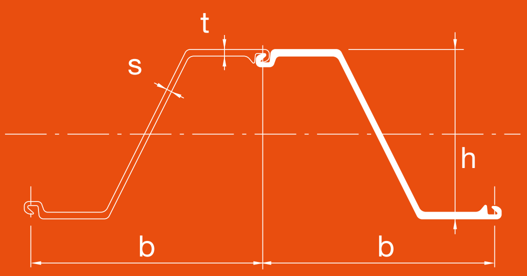


Preliminary design



Solutions for execution details

Z-Sections



The essential characteristics of Z-sections include the continuous form of the web and the location of the interlock symmetrically on each side of the neutral axis. Both aspects create a positive influence on the section modulus. The AZ® series, a section with extraordinary characteristics and the proven qualities of the Larssen interlock, has the following advantages:

– extremely competitive section-modulus-to-mass ratio;
– increased inertia for reduced deflection;
– large width, resulting in competitive installation performance;
– good corrosion resistance, the steel 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$^{1)}$						
	b mm	h mm	t mm	s mm	cm^2/m	single pile kg/m	wall kg/m^2	cm^4/m	cm^3/m	cm^3/m	cm^3/m	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 AP
AZ®-800																		
AZ 18-800	800	449	8.5	8.5	129	80.7	**101**	41320	**1840**	1065	2135	3	3	3	3	3	4	4
AZ 20-800	800	450	9.5	9.5	141	88.6	**111**	45050	**2000**	1165	2330	3	3	3	3	3	3	3
AZ 22-800	800	451	10.5	10.5	153	96.4	**120**	48790	**2165**	1260	2525	2	2	3	3	3	3	3
AZ 23-800	800	474	11.5	9.0	151	94.6	**118**	55260	**2330**	1340	2680	2	2	2	3	3	3	3
AZ 25-800	800	475	12.5	10.0	163	102.6	**128**	59410	**2500**	1445	2890	2	2	2	2	2	3	3
AZ 27-800	800	476	13.5	11.0	176	110.5	**138**	63570	**2670**	1550	3100	2	2	2	2	2	2	2
AZ®-750																		
AZ 28-750	750	509	12.0	10.0	171	100.8	**134**	71540	**2810**	1620	3245	2	2	2	2	3	3	3
AZ 30-750	750	510	13.0	11.0	185	108.8	**145**	76670	**3005**	1740	3485	2	2	2	2	2	2	3
AZ 32-750	750	511	14.0	12.0	198	116.7	**156**	81800	**3200**	1860	3720	2	2	2	2	2	2	2
AZ®-700 and AZ®-770																		
AZ 12-770	770	344	8.5	8.5	120	72.6	**94**	21430	**1245**	740	1480	2	2	3	3	3	3	3
AZ 13-770	770	344	9.0	9.0	126	76.1	**99**	22360	**1300**	775	1546	2	2	3	3	3	3	3
AZ 14-770	770	345	9.5	9.5	132	79.5	**103**	23300	**1355**	805	1611	2	2	2	2	3	3	3
AZ 14-770-10/10	770	345	10.0	10.0	137	82.9	**108**	24240	**1405**	840	1677	2	2	2	2	2	3	3
AZ 12-700	700	314	8.5	8.5	123	67.7	**97**	18880	**1205**	710	1415	2	2	3	3	3	3	3
AZ 13-700	700	315	9.5	9.5	135	74.0	**106**	20540	**1305**	770	1540	2	2	2	3	3	3	3
AZ 13-700-10/10	700	316	10.0	10.0	140	77.2	**110**	21370	**1355**	800	1600	2	2	2	2	3	3	3
AZ 14-700	700	316	10.5	10.5	146	80.3	**115**	22190	**1405**	835	1665	2	2	2	2	2	3	3
AZ 17-700	700	420	8.5	8.5	133	73.1	**104**	36230	**1730**	1015	2027	2	2	3	3	3	3	3
AZ 18-700	700	420	9.0	9.0	139	76.5	**109**	37800	**1800**	1060	2116	2	2	3	3	3	3	3
AZ 19-700	700	421	9.5	9.5	146	80.0	**114**	39380	**1870**	1105	2206	2	2	2	3	3	3	3
AZ 20-700	700	421	10.0	10.0	152	83.5	**119**	40960	**1945**	1150	2296	2	2	2	2	2	3	3
AZ 24-700	700	459	11.2	11.2	174	95.7	**137**	55820	**2430**	1435	2867	2	2	2	2	2	2	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
AZ 28-700	700	461	13.2	13.2	200	110.0	**157**	63620	**2760**	1635	3273	2	2	2	2	2	2	2

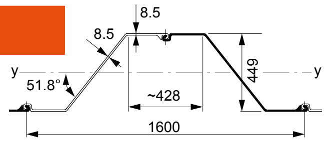
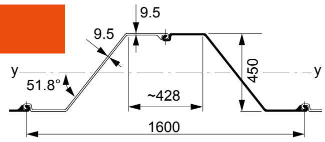
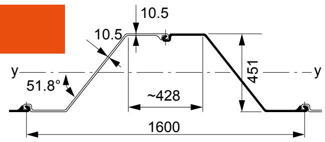
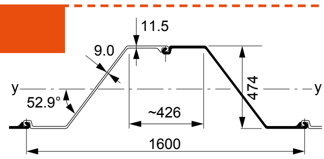
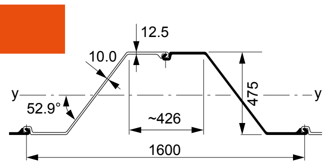
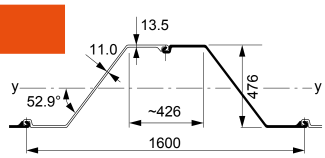
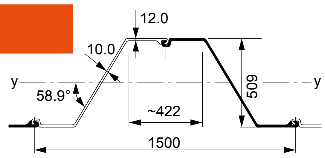
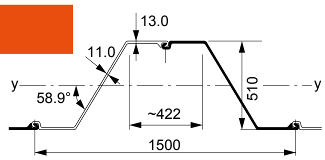
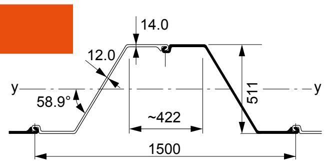
Section	Width	Height	Thickness		Sectional area	Mass		Moment of inertia	Elastic section modulus	Static moment	Plastic section modulus	Class[1]						
	b mm	h mm	t mm	s mm	cm^2/m	single pile kg/m	wall kg/m^2	cm^4/m	cm^3/m	cm^3/m	cm^3/m	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 AP
AZ®-700 and AZ®-770																		
AZ 36-700N	700	499	15.0	11.2	216	118.6	**169**	89610	**3590**	2055	4110	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
AZ 40-700N	700	501	17.0	13.2	244	134.2	**192**	100080	**3995**	2305	4605	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
AZ 44-700N	700	500	19.0	15.0	273	149.9	**214**	110150	**4405**	2550	5105	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
AZ 48-700	700	503	22.0	15.0	288	158.5	**226**	119650	**4755**	2745	5490	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
AZ 52-700	700	505	24.0	17.0	317	174.1	**249**	130140	**5155**	2990	5985	2	2	2	2	2	2	2
AZ®																		
AZ 18[2]	630	380	9.5	9.5	150	74.4	**118**	34200	**1800**	1050	2104	2	2	2	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
AZ 26[2]	630	427	13.0	12.2	198	97.8	**155**	55510	**2600**	1530	3059	2	2	2	2	2	2	2

[1] Classification according to EN 1993-5. Class 1 is obtained by verification of the rotation capacity for a class-2 cross-section.

[2] Can be rolled-up or down by 0.5 mm and 1.0 mm on request.

A set of tables with all the data required for design in accordance with EN 1993-5 is available from our Technical Department.

Tailor made profiles can be rolled on request.

Section	S = Single pile D = Double pile	Sectional area cm^2	Mass kg/m	Moment of inertia cm^4	Elastic section modulus cm^3	Radius of gyration cm	Coating area[1] m^2/m
AZ®-800							
AZ 18-800 	Per S	102.9	**80.7**	33055	**1470**	17.93	1.04
	Per D	205.7	**161.5**	66110	**2945**	17.93	2.08
	Per m of wall	128.6	**100.9**	41320	**1840**	17.93	1.30
AZ 20-800 	Per S	112.8	**88.6**	36040	**1600**	17.87	1.04
	Per D	225.6	**177.1**	72070	**3205**	17.87	2.08
	Per m of wall	141.0	**110.7**	45050	**2000**	17.87	1.30
AZ 22-800 	Per S	122.8	**96.4**	39035	**1730**	17.83	1.04
	Per D	245.6	**192.8**	78070	**3460**	17.83	2.08
	Per m of wall	153.5	**120.5**	48790	**2165**	17.83	1.30
AZ 23-800 	Per S	120.5	**94.6**	44200	**1865**	19.15	1.06
	Per D	241.0	**189.2**	88410	**3730**	19.15	2.11
	Per m of wall	150.6	**118.2**	55260	**2330**	19.15	1.32
AZ 25-800 	Per S	130.6	**102.6**	47530	**2000**	19.07	1.06
	Per D	261.3	**205.1**	95060	**4005**	19.07	2.11
	Per m of wall	163.3	**128.2**	59410	**2500**	19.07	1.32
AZ 27-800 	Per S	140.8	**110.5**	50860	**2135**	19.01	1.06
	Per D	281.6	**221.0**	101720	**4275**	19.01	2.11
	Per m of wall	176.0	**138.1**	63570	**2670**	19.01	1.32
AZ®-750							
AZ 28-750 	Per S	128.4	**100.8**	53650	**2110**	20.44	1.06
	Per D	256.8	**201.6**	107310	**4215**	20.44	2.11
	Per m of wall	171.2	**134.4**	71540	**2810**	20.44	1.41
AZ 30-750 	Per S	138.5	**108.8**	57500	**2255**	20.37	1.06
	Per D	277.1	**217.5**	115000	**4510**	20.37	2.11
	Per m of wall	184.7	**145.0**	76670	**3005**	20.37	1.41
AZ 32-750 	Per S	148.7	**116.7**	61350	**2400**	20.31	1.06
	Per D	297.4	**233.5**	122710	**4805**	20.31	2.11
	Per m of wall	198.3	**155.6**	81800	**3200**	20.31	1.41

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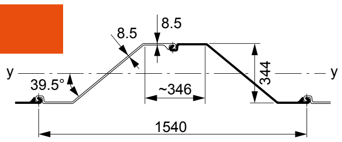
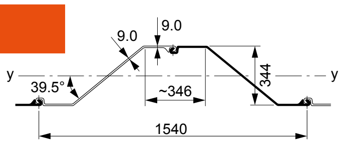
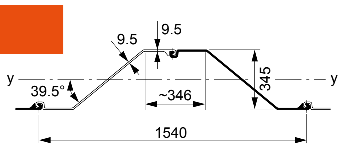
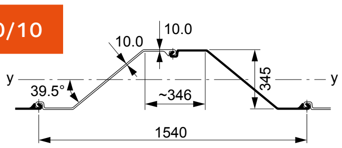
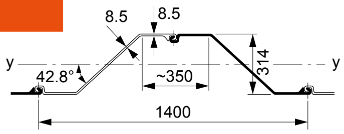
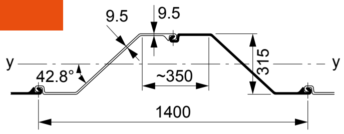
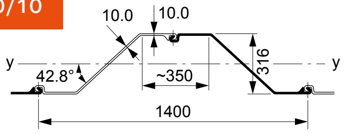
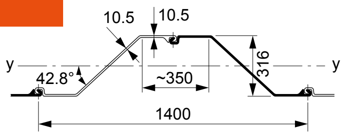
[1] One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile	Sectional area cm^2	Mass kg/m	Moment of inertia cm^4	Elastic section modulus cm^3	Radius of gyration cm	Coating area[1] m^2/m
AZ®-700 and AZ®-770							
AZ 12-770 	Per S	92.5	**72.6**	16500	**960**	13.36	0.93
	Per D	185.0	**145.2**	33000	**1920**	13.36	1.85
	Per m of wall	120.1	**94.3**	21430	**1245**	13.36	1.20
AZ 13-770 	Per S	96.9	**76.1**	17220	**1000**	13.33	0.93
	Per D	193.8	**152.1**	34440	**2000**	13.33	1.85
	Per m of wall	125.8	**98.8**	22360	**1300**	13.33	1.20
AZ 14-770 	Per S	101.3	**79.5**	17940	**1040**	13.31	0.93
	Per D	202.6	**159.0**	35890	**2085**	13.31	1.85
	Per m of wall	131.5	**103.2**	23300	**1355**	13.31	1.20
AZ 14-770-10/10 	Per S	105.6	**82.9**	18670	**1085**	13.30	0.93
	Per D	211.2	**165.8**	37330	**2165**	13.30	1.85
	Per m of wall	137.2	**107.7**	24240	**1405**	13.30	1.20
AZ 12-700 	Per S	86.2	**67.7**	13220	**840**	12.38	0.86
	Per D	172.5	**135.4**	26440	**1685**	12.38	1.71
	Per m of wall	123.2	**96.7**	18880	**1205**	12.38	1.22
AZ 13-700 	Per S	94.3	**74.0**	14370	**910**	12.35	0.86
	Per D	188.5	**148.0**	28750	**1825**	12.35	1.71
	Per m of wall	134.7	**105.7**	20540	**1305**	12.35	1.22
AZ 13-700-10/10 	Per S	98.3	**77.2**	14960	**945**	12.33	0.86
	Per D	196.6	**154.3**	29910	**1895**	12.33	1.71
	Per m of wall	140.4	**110.2**	21370	**1355**	12.33	1.22
AZ 14-700 	Per S	102.3	**80.3**	15530	**980**	12.32	0.86
	Per D	204.6	**160.6**	31060	**1965**	12.32	1.71
	Per m of wall	146.1	**114.7**	22190	**1405**	12.32	1.22

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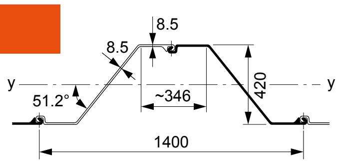
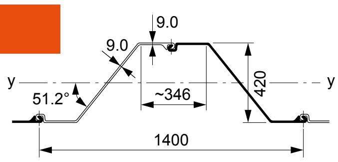
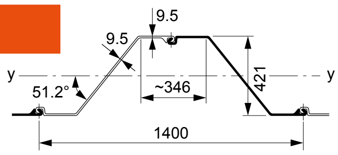
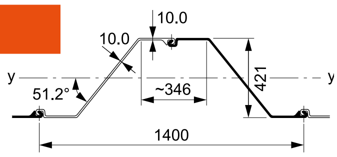
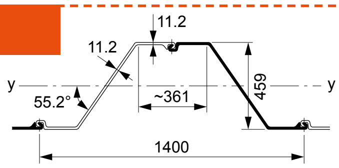
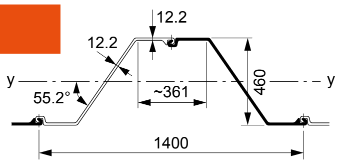
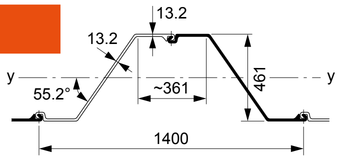
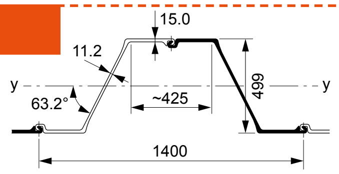
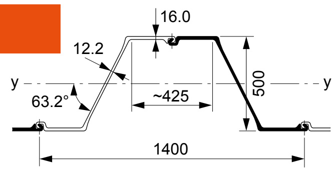
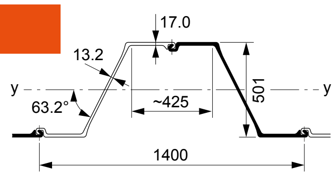
[1] One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile	Sectional area cm^2	Mass kg/m	Moment of inertia cm^4	Elastic section modulus cm^3	Radius of gyration cm	Coating area[1] m^2/m
AZ®-700 and AZ®-770							
AZ 17-700 	Per S	93.1	**73.1**	25360	**1210**	16.50	0.93
	Per D	186.2	**146.2**	50720	**2420**	16.50	1.86
	Per m of wall	133.0	**104.4**	36230	**1730**	16.50	1.33
AZ 18-700 	Per S	97.5	**76.5**	26460	**1260**	16.47	0.93
	Per D	194.9	**153.0**	52920	**2520**	16.47	1.86
	Per m of wall	139.2	**109.3**	37800	**1800**	16.47	1.33
AZ 19-700 	Per S	101.9	**80.0**	27560	**1310**	16.44	0.93
	Per D	203.8	**160.0**	55130	**2620**	16.44	1.86
	Per m of wall	145.6	**114.3**	39380	**1870**	16.44	1.33
AZ 20-700 	Per S	106.4	**83.5**	28670	**1360**	16.42	0.93
	Per D	212.8	**167.0**	57340	**2725**	16.42	1.86
	Per m of wall	152.0	**119.3**	40960	**1945**	16.42	1.33
AZ 24-700 	Per S	121.9	**95.7**	39080	**1700**	17.90	0.97
	Per D	243.8	**191.4**	78150	**3405**	17.90	1.93
	Per m of wall	174.1	**136.7**	55820	**2430**	17.90	1.38
AZ 26-700 	Per S	131.0	**102.9**	41800	**1815**	17.86	0.97
	Per D	262.1	**205.7**	83610	**3635**	17.86	1.93
	Per m of wall	187.2	**146.9**	59720	**2600**	17.86	1.38
AZ 28-700 	Per S	140.2	**110.0**	44530	**1930**	17.83	0.97
	Per D	280.3	**220.1**	89070	**3865**	17.83	1.93
	Per m of wall	200.2	**157.2**	63620	**2760**	17.83	1.38
AZ 36-700N 	Per S	151.1	**118.6**	62730	**2510**	20.37	1.03
	Per D	302.2	**237.3**	125450	**5030**	20.37	2.05
	Per m of wall	215.9	**169.5**	89610	**3590**	20.37	1.47
AZ 38-700N 	Per S	161.0	**126.4**	66390	**2655**	20.31	1.03
	Per D	322.0	**252.8**	132780	**5310**	20.31	2.05
	Per m of wall	230.0	**180.6**	94840	**3795**	20.31	1.47
AZ 40-700N 	Per S	170.9	**134.2**	70060	**2795**	20.25	1.03
	Per D	341.9	**268.4**	140110	**5595**	20.25	2.05
	Per m of wall	244.2	**191.7**	100080	**3995**	20.25	1.47

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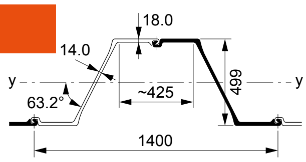
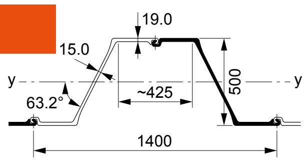
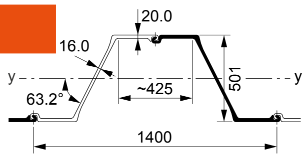
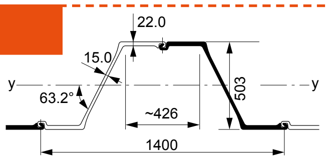
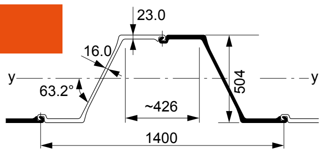
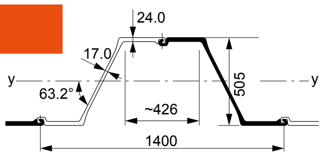
[1] One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area[1]
		cm^2	kg/m	cm^4	cm^3	cm	m^2/m
AZ®-700 and AZ®-770							
AZ 42-700N 	Per S	181.1	**142.1**	73450	**2945**	20.14	1.03
	Per D	362.1	**284.3**	146900	**5890**	20.14	2.06
	Per m of wall	258.7	**203.1**	104930	**4205**	20.14	1.47
AZ 44-700N 	Per S	191.0	**149.9**	77100	**3085**	20.09	1.03
	Per D	382.0	**299.8**	154210	**6170**	20.09	2.06
	Per m of wall	272.8	**214.2**	110150	**4405**	20.09	1.47
AZ 46-700N 	Per S	200.9	**157.7**	80760	**3220**	20.05	1.03
	Per D	401.8	**315.4**	161520	**6450**	20.05	2.06
	Per m of wall	287.0	**225.3**	115370	**4605**	20.05	1.47
AZ 48-700 	Per S	201.9	**158.5**	83760	**3330**	20.37	1.02
	Per D	403.8	**317.0**	167510	**6660**	20.37	2.04
	Per m of wall	288.4	**226.4**	119650	**4755**	20.37	1.46
AZ 50-700 	Per S	211.8	**166.3**	87430	**3470**	20.32	1.02
	Per D	423.6	**332.5**	174850	**6940**	20.32	2.04
	Per m of wall	302.6	**237.5**	124890	**4955**	20.32	1.46
AZ 52-700 	Per S	221.7	**174.1**	91100	**3610**	20.27	1.02
	Per D	443.5	**348.1**	182200	**7215**	20.27	2.04
	Per m of wall	316.8	**248.7**	130140	**5155**	20.27	1.46

[1] One side, excluding inside of interlocks.

Coastal defense project, Colwyn Bay, UK

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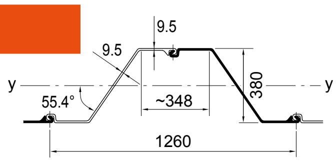
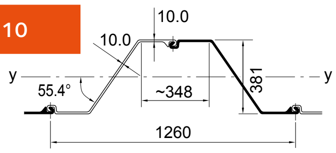
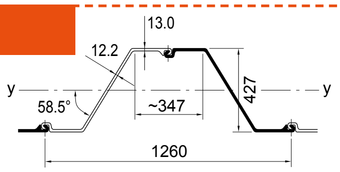
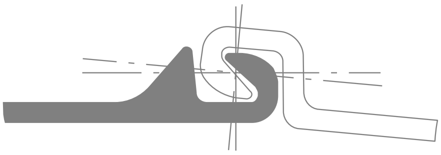
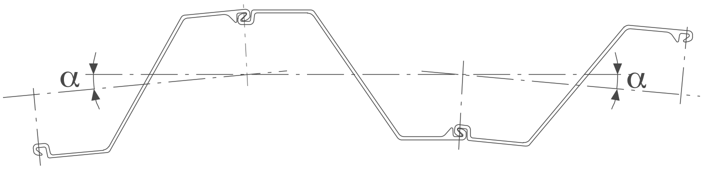
Section	S = Single pile D = Double pile	Sectional area cm^2	Mass kg/m	Moment of inertia cm^4	Elastic section modulus cm^3	Radius of gyration cm	Coating area[1] m^2/m
AZ®							
AZ 18 	Per S	94.8	**74.4**	21540	**1135**	15.07	0.86
	Per D	189.6	**148.8**	43080	**2270**	15.07	1.71
	Per m of wall	150.4	**118.1**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

[1] One side, excluding inside of interlocks.

Boardwalk, Aarschot, Belgium

Interlock

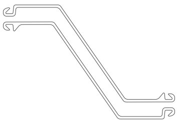




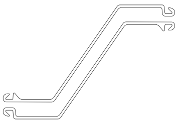
AZ® Larssen interlock in accordance with EN 10248.
All available AZ sheet piles can be interlocked, as well as the AU, PU and GU (except GU-400).
Theoretical interlock swing: $\alpha_{max} = 5^\circ$.

Delivery form

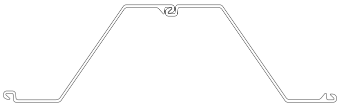
Single Pile
Position A



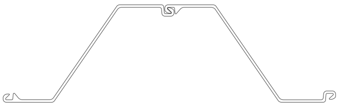
Single Pile
Position B



Double Pile
Form I (standard)

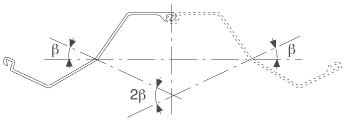


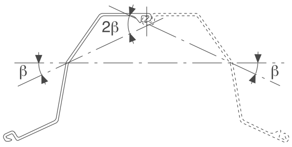
Double Pile
Form II (on request)



Bent piles

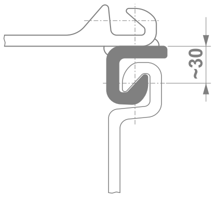
Maximum bending angle: $\beta = 25^\circ$. Z-piles are usually bent in the middle of the web. They are generally delivered as single piles. Double piles are available upon request.



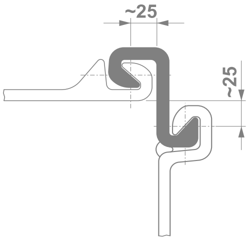


Corner sections

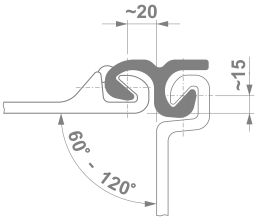
C 9
Mass ~ 9.3 kg/m
Coating area 0.15 m²/m



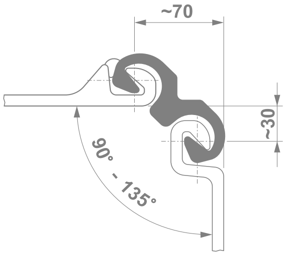
C 14
Mass ~ 14.4 kg/m
Coating area 0.22 m²/m



DELTA 13
Mass ~ 13.1 kg/m
Coating area 0.19 m²/m



OMEGA 18
Mass ~ 18.0 kg/m
Coating area 0.24 m²/m

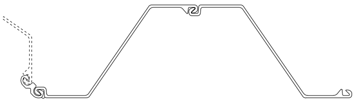


Special corner sections interlocking with U and Z-sections make it possible to form corner or junction piles without using fabricated special piles. Corner sections are fixed to the sheet pile in accordance with EN 12063.

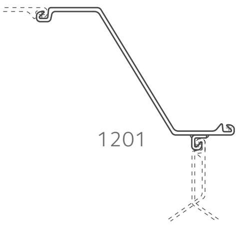
Different welding specifications are available on request. The corner sections are threaded and welded with usually a 200 mm setback from the top of the piles.

Corner and junction piles

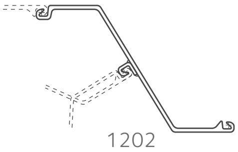
The following special piles, among others, are available as single and double piles on request.



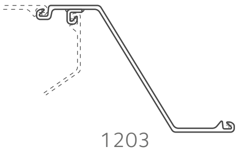
1051



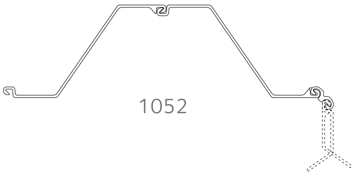
1201



1202



1203



1052

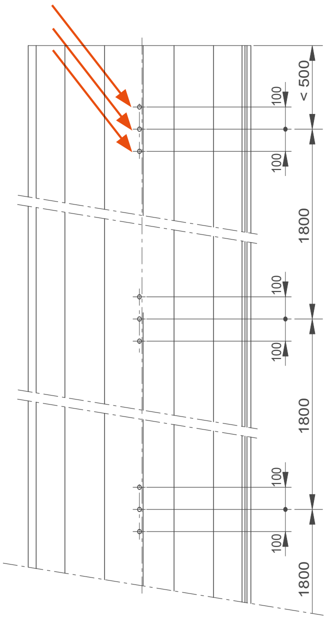
Crimping

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.

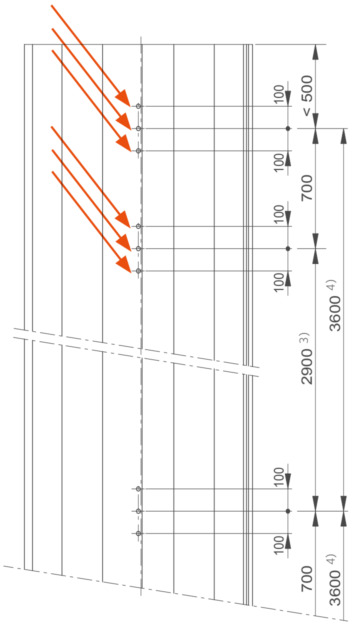
Pile length < 6 m:
3 crimping points per 1.8 m
= 1.7 crimping points per m[1]

Pile length ≥ 6 m:
6 crimping points per 3.6 m[2]
= 1.7 crimping points per m[1]

3 crimping points



6 crimping points



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[1] Amount and layout of crimping points may differ at both ends; Varying for the profiles AZ 38-700N, AZ 44-700N and AZ 50-700 as well as their derivatives; Special crimping on request.

[2] 6 crimping points per 2.1 m for the profiles AZ 38-700N, AZ 44-700N and AZ 50-700 as well as their derivatives.

[3] 1400 mm for the profiles AZ 38-700N, AZ 44-700N and AZ 50-700 as well as their derivatives.

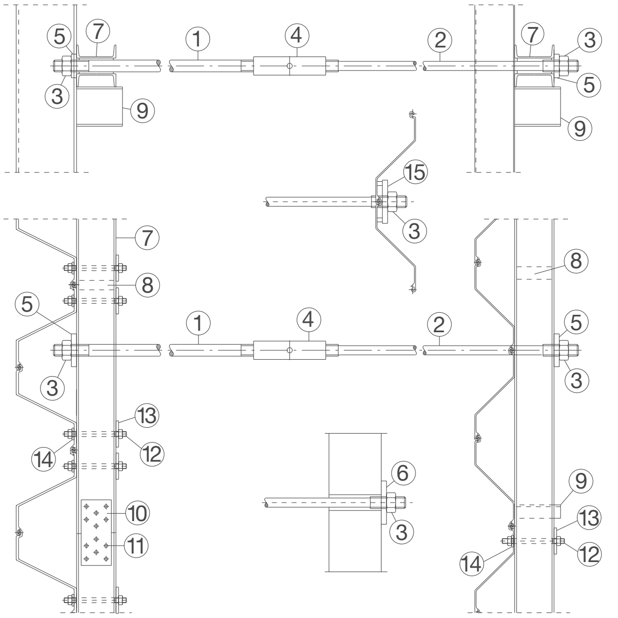
[4] 2100 mm for the profiles AZ 38-700N, AZ 44-700N and AZ 50-700 as well as their derivatives.

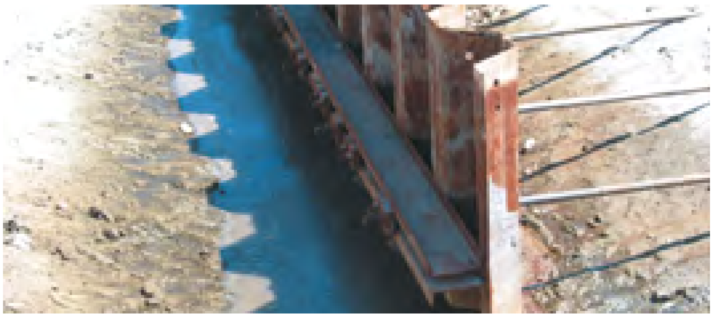
Tie back system

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
2 Upset end tie-rod
3 Nut
4 Turnbuckle
5 Bearing plate
6 Bearing plate
on concrete

7 Waling
8 Spacer
9 Supporting bracket
10 Splicing plate
11 Splicing bolt
12 Fixing bolt
13
14 – Fixing plate
15



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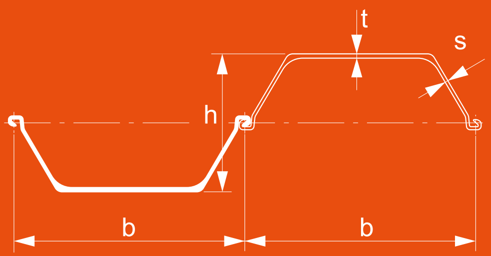
U-Sections



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$^{1)}$						
	b mm	h mm	t mm	s mm	cm^2/m	single pile kg/m	wall kg/m^2	cm^4/m	cm^3/m	cm^3/m	cm^3/m	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 AP
AU™ sections																		
AU 14	750	408	10.0	8.3	132	77.9	**104**	28680	**1405**	820	1663	2	2	3	3	3	3	3
AU 16	750	411	11.5	9.3	147	86.3	**115**	32850	**1600**	935	1891	2	2	2	2	2	3	3
AU 18	750	441	10.5	9.1	150	88.5	**118**	39300	**1780**	1030	2082	2	3	3	3	3	3	3
AU 20	750	444	12.0	10.0	165	96.9	**129**	44440	**2000**	1155	2339	2	2	2	3	3	3	3
AU 23	750	447	13.0	9.5	173	102.1	**136**	50700	**2270**	1285	2600	2	2	2	3	3	3	3
AU 25	750	450	14.5	10.2	188	110.4	**147**	56240	**2500**	1420	2866	2	2	2	2	2	3	3
PU® sections																		
PU 12	600	360	9.8	9.0	140	66.1	**110**	21600	**1200**	715	1457	-	-	-	2	2	2	3
PU 12S	600	360	10.0	10.0	151	71.0	**118**	22660	**1260**	755	1543	-	-	-	2	2	2	2
PU 18^{-1}	600	430	10.2	8.4	154	72.6	**121**	35950	**1670**	980	1988	2	2	2	2	2	3	3
PU 18	600	430	11.2	9.0	163	76.9	**128**	38650	**1800**	1055	2134	2	2	2	2	2	2	2
PU 18^{+1}	600	430	12.2	9.5	172	81.1	**135**	41320	**1920**	1125	2280	2	2	2	2	2	2	2
PU 22^{-1}	600	450	11.1	9.0	174	81.9	**137**	46380	**2060**	1195	2422	2	2	2	2	2	3	3
PU 22	600	450	12.1	9.5	183	86.1	**144**	49460	**2200**	1275	2580	2	2	2	2	2	2	2
PU 22^{+1}	600	450	13.1	10.0	192	90.4	**151**	52510	**2335**	1355	2735	2	2	2	2	2	2	2
PU 28^{-1}	600	452	14.2	9.7	207	97.4	**162**	60580	**2680**	1525	3087	2	2	2	2	2	2	2
PU 28	600	454	15.2	10.1	216	101.8	**170**	64460	**2840**	1620	3269	2	2	2	2	2	2	2
PU 28^{+1}	600	456	16.2	10.5	226	106.2	**177**	68380	**3000**	1710	3450	2	2	2	2	2	2	2
PU 32^{-1}	600	452	18.5	10.6	233	109.9	**183**	69210	**3065**	1745	3525	2	2	2	2	2	2	2
PU 32	600	452	19.5	11.0	242	114.1	**190**	72320	**3200**	1825	3687	2	2	2	2	2	2	2
PU 32^{+1}	600	452	20.5	11.4	251	118.4	**197**	75410	**3340**	1905	3845	2	2	2	2	2	2	2
GU® sections																		
GU 6N	600	309	6.0	6.0	89	41.9	**70**	9670	**625**	375	765	3	3	3	4	4	4	4
GU 7N	600	310	6.5	6.4	94	44.1	**74**	10450	**675**	400	825	3	3	3	3	3	4	4
GU 7S	600	311	7.2	6.9	98	46.3	**77**	11540	**740**	440	900	2	2	3	3	3	3	3
GU 7HWS	600	312	7.3	6.9	101	47.4	**79**	11620	**745**	445	910	2	2	3	3	3	3	3
GU 8N	600	312	7.5	7.1	103	48.5	**81**	12010	**770**	460	935	2	2	3	3	3	3	3
GU 8S	600	313	8.0	7.5	108	50.8	**85**	12800	**820**	490	995	2	2	2	3	3	3	3

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

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

[1] Classification according to EN 1993-5. Class 1 is obtained by verification of the rotation capacity for a class 2 cross-section.
A set of tables with all the data required for design in accordance with EN 1993-5 is available from our Technical Department.
PU® sections can be rolled-up or -down by 0.5 mm and 1.0 mm. Tailor made profiles can be rolled on request.

Characteristics – AU™ sections

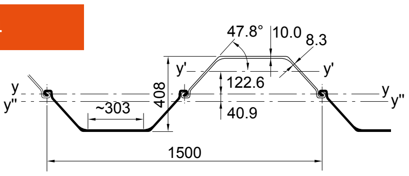
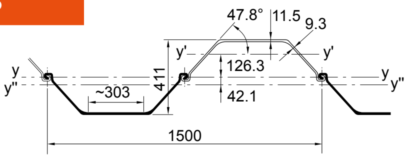
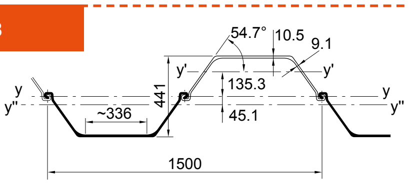
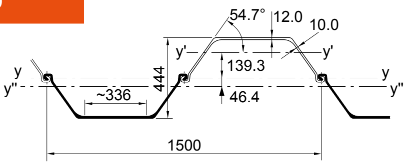
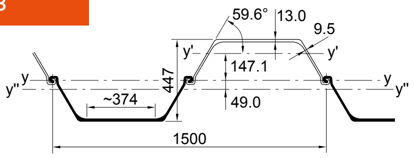
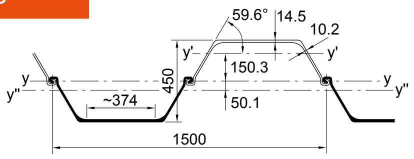
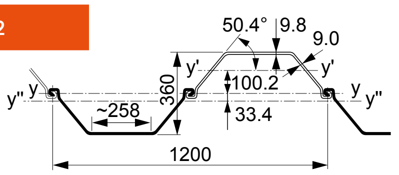
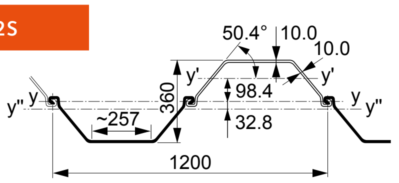
A weight reduction of about 10% compared to the 600 mm PU series has been achieved by optimising the geometric dimensions. The increased width **allows faster installation,** reduces the amount of coating required, due to the smaller perimeter, and increases watertightness thanks to fewer interlocks 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® 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® 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[1]
		cm²	kg/m	cm⁴	cm³	cm	m²/m
AU™ sections							
AU 14 	Per S	99.2	**77.9**	6590	**457**	8.15	0.96
	Per D	198.5	**155.8**	43020	**2110**	14.73	1.91
	Per T	297.7	**233.7**	59550	**2435**	14.15	2.86
	Per m of wall	132.3	**103.8**	28680	**1405**	14.73	1.27
AU 16 	Per S	109.9	**86.3**	7110	**481**	8.04	0.96
	Per D	219.7	**172.5**	49280	**2400**	14.98	1.91
	Per T	329.6	**258.7**	68080	**2750**	14.37	2.86
	Per m of wall	146.5	**115.0**	32850	**1600**	14.98	1.27
AU 18 	Per S	112.7	**88.5**	8760	**554**	8.82	1.01
	Per D	225.5	**177.0**	58950	**2670**	16.17	2.00
	Per T	338.2	**265.5**	81520	**3065**	15.53	2.99
	Per m of wall	150.3	**118.0**	39300	**1780**	16.17	1.33
AU 20 	Per S	123.4	**96.9**	9380	**579**	8.72	1.01
	Per D	246.9	**193.8**	66660	**3000**	16.43	2.00
	Per T	370.3	**290.7**	92010	**3425**	15.76	2.99
	Per m of wall	164.6	**129.2**	44440	**2000**	16.43	1.33
AU 23 	Per S	130.1	**102.1**	9830	**579**	8.69	1.03
	Per D	260.1	**204.2**	76050	**3405**	17.10	2.04
	Per T	390.2	**306.3**	104680	**3840**	16.38	3.05
	Per m of wall	173.4	**136.1**	50700	**2270**	17.10	1.36
AU 25 	Per S	140.6	**110.4**	10390	**601**	8.60	1.03
	Per D	281.3	**220.8**	84370	**3750**	17.32	2.04
	Per T	422.0	**331.3**	115950	**4215**	16.58	3.05
	Per m of wall	187.5	**147.2**	56240	**2500**	17.32	1.36
PU® sections							
PU 12 	Per S	84.2	**66.1**	4500	**370**	7.31	0.80
	Per D	168.4	**132.2**	25920	**1440**	12.41	1.59
	Per T	252.6	**198.3**	36060	**1690**	11.95	2.38
	Per m of wall	140.0	**110.1**	21600	**1200**	12.41	1.32
PU 12S 	Per S	90.5	**71.0**	4830	**400**	7.30	0.80
	Per D	181.0	**142.1**	27190	**1510**	12.26	1.59
	Per T	271.5	**213.1**	37860	**1780**	11.81	2.38
	Per m of wall	150.8	**118.4**	22660	**1260**	12.26	1.32

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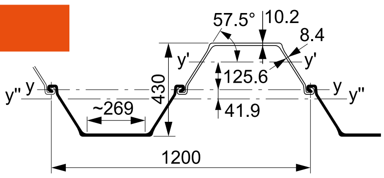
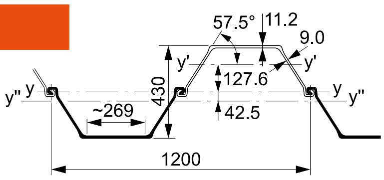
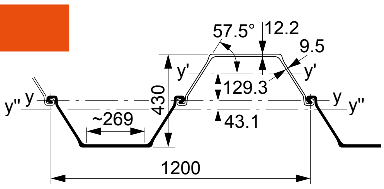
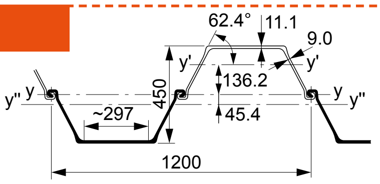
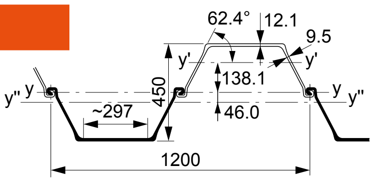
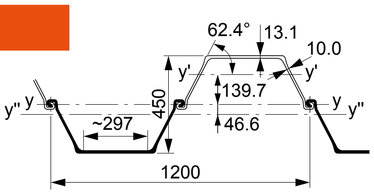
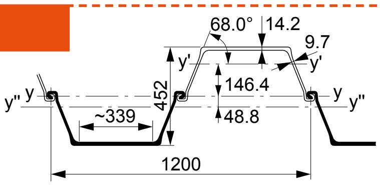
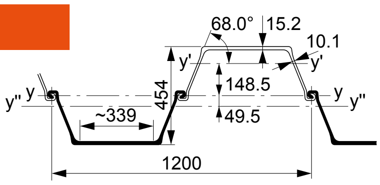
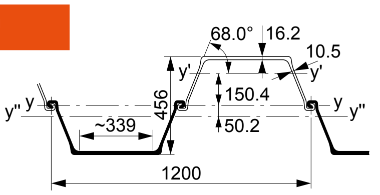
[1] One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile T = Triple pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area[1]
		cm^2	kg/m	cm^4	cm^3	cm	m^2/m
PU® sections							
PU 18^{-1} 	Per S	92.5	**72.6**	6960	**475**	8.67	0.87
	Per D	185.0	**145.2**	43140	**2005**	15.30	1.72
	Per T	277.5	**217.8**	59840	**2330**	14.69	2.58
	Per m of wall	154.2	**121.0**	35950	**1670**	15.30	1.43
PU 18 	Per S	98.0	**76.9**	7220	**485**	8.58	0.87
	Per D	196.0	**153.8**	46380	**2160**	15.38	1.72
	Per T	294.0	**230.7**	64240	**2495**	14.78	2.58
	Per m of wall	163.3	**128.2**	38650	**1800**	15.38	1.43
PU 18^{+1} 	Per S	103.4	**81.1**	7480	**495**	8.51	0.87
	Per D	206.8	**162.3**	49580	**2305**	15.49	1.72
	Per T	310.2	**243.5**	68600	**2655**	14.87	2.58
	Per m of wall	172.3	**135.2**	41320	**1920**	15.49	1.43
PU 22^{-1} 	Per S	104.3	**81.9**	8460	**535**	9.01	0.90
	Per D	208.7	**163.8**	55650	**2475**	16.33	1.79
	Per T	313.0	**245.7**	77020	**2850**	15.69	2.68
	Per m of wall	173.9	**136.5**	46380	**2060**	16.33	1.49
PU 22 	Per S	109.7	**86.1**	8740	**546**	8.93	0.90
	Per D	219.5	**172.3**	59360	**2640**	16.45	1.79
	Per T	329.2	**258.4**	82060	**3025**	15.79	2.68
	Per m of wall	182.9	**143.6**	49460	**2200**	16.45	1.49
PU 22^{+1} 	Per S	115.2	**90.4**	9020	**555**	8.85	0.90
	Per D	230.4	**180.9**	63010	**2800**	16.54	1.79
	Per T	345.6	**271.3**	87020	**3205**	15.87	2.68
	Per m of wall	192.0	**150.7**	52510	**2335**	16.54	1.49
PU 28^{-1} 	Per S	124.1	**97.4**	9740	**576**	8.86	0.93
	Per D	248.2	**194.8**	72700	**3215**	17.12	1.85
	Per T	372.3	**292.2**	100170	**3645**	16.40	2.77
	Per m of wall	206.8	**162.3**	60580	**2680**	17.12	1.54
PU 28 	Per S	129.7	**101.8**	10070	**589**	8.81	0.93
	Per D	259.4	**203.6**	77350	**3405**	17.27	1.85
	Per T	389.0	**305.4**	106490	**3850**	16.55	2.77
	Per m of wall	216.1	**169.6**	64460	**2840**	17.27	1.54
PU 28^{+1} 	Per S	135.3	**106.2**	10400	**600**	8.77	0.93
	Per D	270.7	**212.5**	82060	**3600**	17.41	1.85
	Per T	406.0	**318.7**	112870	**4060**	16.67	2.77
	Per m of wall	225.6	**177.1**	68380	**3000**	17.41	1.54

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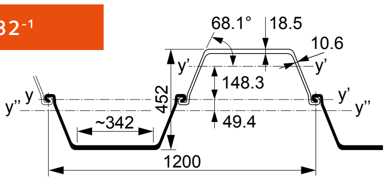
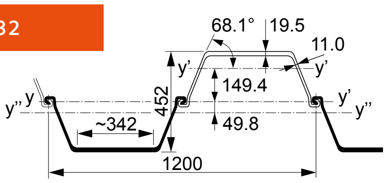
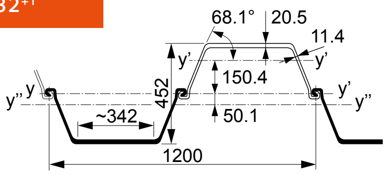
[1] One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile T = Triple pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area1)
		cm^2	kg/m	cm^4	cm^3	cm	m^2/m
PU® sections							
PU 32^{-1} 	Per S	140.0	**109.9**	10740	**625**	8.76	0.92
	Per D	280.0	**219.8**	83050	**3675**	17.22	1.83
	Per T	420.0	**329.7**	114310	**4150**	16.50	2.74
	Per m of wall	233.3	**183.2**	69210	**3065**	17.22	1.52
PU 32 	Per S	145.4	**114.1**	10950	**633**	8.68	0.92
	Per D	290.8	**228.3**	86790	**3840**	17.28	1.83
	Per T	436.2	**342.4**	119370	**4330**	16.54	2.74
	Per m of wall	242.3	**190.2**	72320	**3200**	17.28	1.52
PU 32^{+1} 	Per S	150.8	**118.4**	11150	**640**	8.60	0.92
	Per D	301.6	**236.8**	90490	**4005**	17.32	1.83
	Per T	452.4	**355.2**	124370	**4505**	16.58	2.74
	Per m of wall	251.3	**197.3**	75410	**3340**	17.32	1.52

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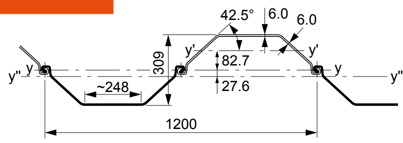
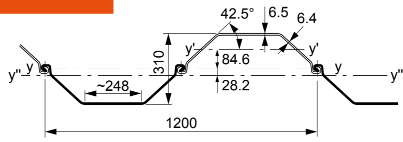
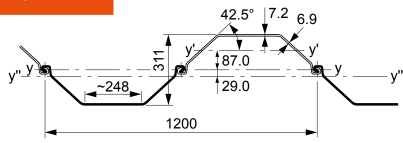
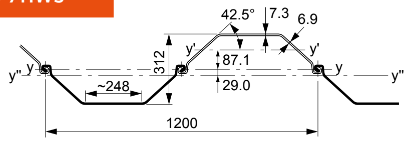
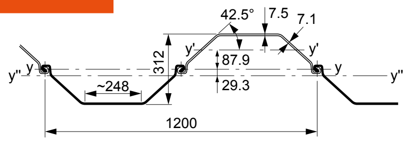
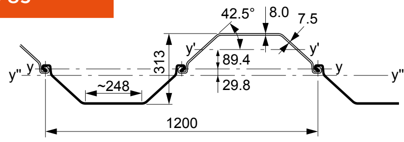
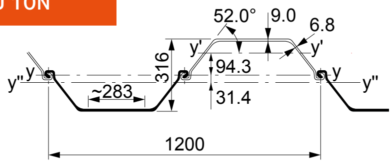
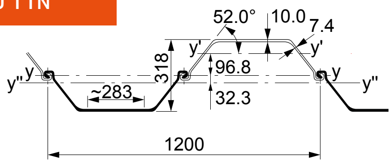
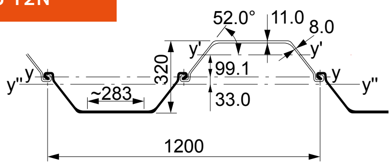
1) One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile T = Triple pile	Sectional area cm^2	Mass kg/m	Moment of inertia cm^4	Elastic section modulus cm^3	Radius of gyration cm	Coating area[1] m^2/m
GU® sections							
GU 6N 	Per S	53.4	**41.9**	2160	**215**	6.36	0.76
	Per D	106.8	**83.8**	11610	**750**	10.43	1.51
	Per T	160.2	**125.7**	16200	**890**	10.06	2.26
	Per m of wall	89.0	**69.9**	9670	**625**	10.43	1.26
GU 7N 	Per S	56.2	**44.1**	2250	**220**	6.33	0.76
	Per D	112.4	**88.2**	12540	**810**	10.56	1.51
	Per T	168.6	**132.4**	17470	**955**	10.18	2.26
	Per m of wall	93.7	**73.5**	10450	**675**	10.56	1.26
GU 7S 	Per S	58.9	**46.3**	2370	**225**	6.35	0.76
	Per D	117.9	**92.5**	13850	**890**	10.84	1.51
	Per T	176.8	**138.8**	19260	**1045**	10.44	2.26
	Per m of wall	98.2	**77.1**	11540	**740**	10.84	1.26
GU 7HWS 	Per S	60.4	**47.4**	2380	**225**	6.28	0.76
	Per D	120.9	**94.9**	13940	**895**	10.74	1.51
	Per T	181.3	**142.3**	19390	**1050**	10.34	2.26
	Per m of wall	100.7	**79.1**	11620	**745**	10.74	1.26
GU 8N 	Per S	61.8	**48.5**	2420	**225**	6.26	0.76
	Per D	123.7	**97.1**	14420	**925**	10.80	1.51
	Per T	185.5	**145.6**	20030	**1080**	10.39	2.26
	Per m of wall	103.1	**80.9**	12010	**770**	10.80	1.26
GU 8S 	Per S	64.7	**50.8**	2510	**230**	6.23	0.76
	Per D	129.3	**101.5**	15360	**980**	10.90	1.51
	Per T	194.0	**152.3**	21320	**1145**	10.48	2.26
	Per m of wall	107.8	**84.6**	12800	**820**	10.90	1.26
GU 10N 	Per S	71.1	**55.8**	3100	**270**	6.60	0.78
	Per D	142.2	**111.6**	18840	**1190**	11.51	1.55
	Per T	213.3	**167.4**	26150	**1380**	11.07	2.32
	Per m of wall	118.5	**93.0**	15700	**995**	11.51	1.29
GU 11N 	Per S	76.7	**60.2**	3280	**280**	6.53	0.78
	Per D	153.4	**120.4**	20930	**1315**	11.68	1.55
	Per T	230.1	**180.7**	29010	**1515**	11.23	2.32
	Per m of wall	127.9	**100.4**	17450	**1095**	11.68	1.29
GU 12N 	Per S	82.3	**64.6**	3450	**290**	6.47	0.78
	Per D	164.7	**129.3**	23060	**1440**	11.83	1.55
	Per T	247.0	**193.9**	31890	**1650**	11.36	2.32
	Per m of wall	137.2	**107.7**	19220	**1200**	11.83	1.29

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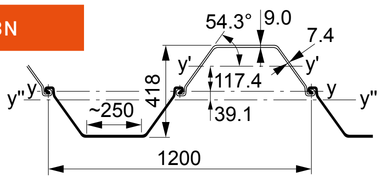
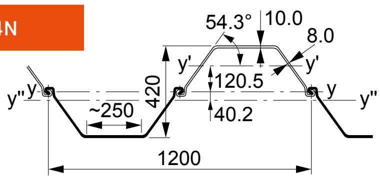
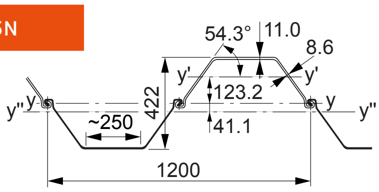
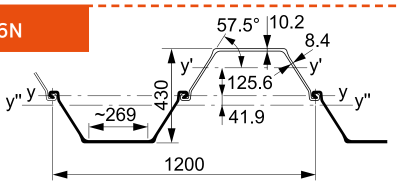
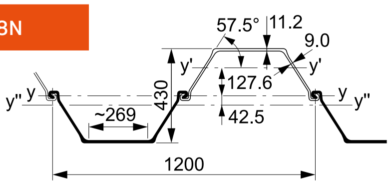
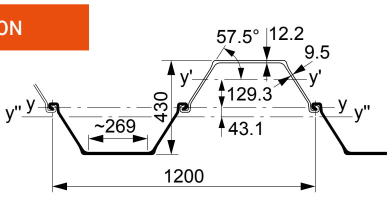
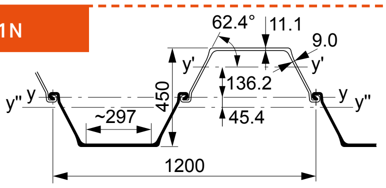
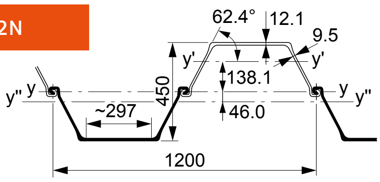
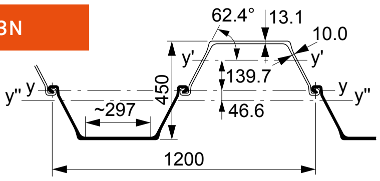
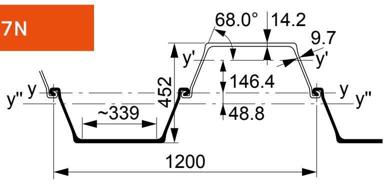
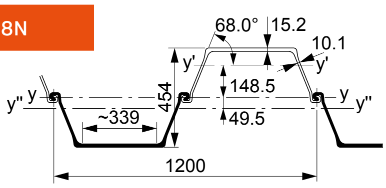
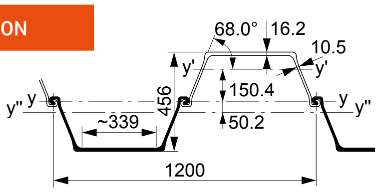
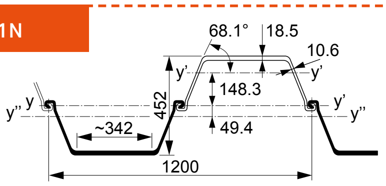
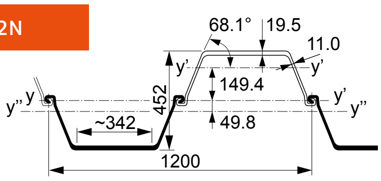
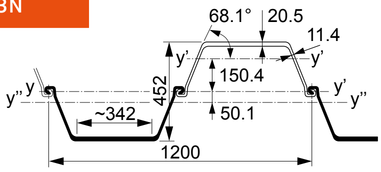
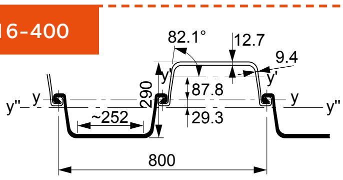
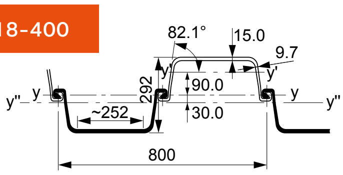
[1] One side, excluding inside of interlocks.

GU® sections

Section	S = Single pile D = Double pile T = Triple pile	Sectional area cm^2	Mass kg/m	Moment of inertia cm^4	Elastic section modulus cm^3	Radius of gyration cm	Coating area[1] m^2/m
GU 13N 	Per S	76.3	**59.9**	5440	**395**	8.44	0.85
	Per D	152.6	**119.8**	31900	**1525**	14.46	1.69
	Per T	228.9	**179.7**	44350	**1785**	13.92	2.53
	Per m of wall	127.2	**99.8**	26590	**1270**	14.46	1.41
GU 14N 	Per S	81.9	**64.3**	5750	**410**	8.38	0.85
	Per D	163.8	**128.6**	35290	**1680**	14.68	1.69
	Per T	245.6	**192.8**	48970	**1955**	14.12	2.53
	Per m of wall	136.5	**107.1**	29410	**1400**	14.68	1.41
GU 15N 	Per S	87.5	**68.7**	6070	**425**	8.33	0.85
	Per D	175.1	**137.4**	38710	**1835**	14.87	1.69
	Per T	262.6	**206.2**	53640	**2130**	14.29	2.53
	Per m of wall	145.9	**114.5**	32260	**1530**	14.87	1.41
GU 16N 	Per S	92.5	**72.6**	6960	**475**	8.67	0.87
	Per D	185.0	**145.2**	43140	**2005**	15.30	1.72
	Per T	277.5	**217.8**	59840	**2330**	14.69	2.58
	Per m of wall	154.2	**121.0**	35950	**1670**	15.30	1.43
GU 18N 	Per S	98.0	**76.9**	7220	**485**	8.58	0.87
	Per D	196.0	**153.8**	46380	**2160**	15.38	1.72
	Per T	294.0	**230.7**	64240	**2495**	14.78	2.58
	Per m of wall	163.3	**128.2**	38650	**1800**	15.38	1.43
GU 20N 	Per S	103.4	**81.1**	7480	**495**	8.51	0.87
	Per D	206.8	**162.3**	49580	**2305**	15.49	1.72
	Per T	310.2	**243.5**	68600	**2655**	14.87	2.58
	Per m of wall	172.3	**135.2**	41320	**1920**	15.49	1.43
GU 21N 	Per S	104.3	**81.9**	8460	**535**	9.01	0.90
	Per D	208.7	**163.8**	55650	**2475**	16.33	1.79
	Per T	313.0	**245.7**	77020	**2850**	15.69	2.68
	Per m of wall	173.9	**136.5**	46380	**2060**	16.33	1.49
GU 22N 	Per S	109.7	**86.1**	8740	**546**	8.93	0.90
	Per D	219.5	**172.3**	59360	**2640**	16.45	1.79
	Per T	329.2	**258.4**	82060	**3025**	15.79	2.68
	Per m of wall	182.9	**143.6**	49460	**2200**	16.45	1.49
GU 23N 	Per S	115.2	**90.4**	9020	**555**	8.85	0.90
	Per D	230.4	**180.9**	63010	**2800**	16.54	1.79
	Per T	345.6	**271.3**	87020	**3205**	15.87	2.68
	Per m of wall	192.0	**150.7**	52510	**2335**	16.54	1.49

[1] 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[1]
		cm²	kg/m	cm⁴	cm³	cm	m²/m
GU® sections							
GU 27N 	Per S	124.1	**97.4**	9740	**576**	8.86	0.93
	Per D	248.2	**194.8**	72700	**3215**	17.12	1.85
	Per T	372.3	**292.2**	100170	**3645**	16.40	2.77
	Per m of wall	206.8	**162.3**	60580	**2680**	17.12	1.54
GU 28N 	Per S	129.7	**101.8**	10070	**589**	8.81	0.93
	Per D	259.4	**203.6**	77350	**3405**	17.27	1.85
	Per T	389.0	**305.4**	106490	**3850**	16.55	2.77
	Per m of wall	216.1	**169.6**	64460	**2840**	17.27	1.54
GU 30N 	Per S	135.3	**106.2**	10400	**600**	8.77	0.93
	Per D	270.7	**212.5**	82060	**3600**	17.41	1.85
	Per T	406.0	**318.7**	112870	**4060**	16.67	2.77
	Per m of wall	225.6	**177.1**	68380	**3000**	17.41	1.54
GU 31N 	Per S	140.0	**109.9**	10740	**625**	8.76	0.92
	Per D	280.0	**219.8**	83050	**3675**	17.22	1.83
	Per T	420.0	**329.7**	114310	**4150**	16.50	2.74
	Per m of wall	233.3	**183.2**	69210	**3065**	17.22	1.52
GU 32N 	Per S	145.4	**114.1**	10950	**633**	8.68	0.92
	Per D	290.8	**228.3**	86790	**3840**	17.28	1.83
	Per T	436.2	**342.4**	119370	**4330**	16.54	2.74
	Per m of wall	242.3	**190.2**	72320	**3200**	17.28	1.52
GU 33N 	Per S	150.8	**118.4**	11150	**640**	8.60	0.92
	Per D	301.6	**236.8**	90490	**4005**	17.32	1.83
	Per T	452.4	**355.2**	124370	**4505**	16.58	2.74
	Per m of wall	251.3	**197.3**	75410	**3340**	17.32	1.52
GU 16-400 	Per S	78.9	**62.0**	2950	**265**	6.11	0.65
	Per D	157.9	**123.9**	18060	**1245**	10.70	1.28
	Per T	236.8	**185.9**	25060	**1440**	10.29	1.92
	Per m of wall	197.3	**154.9**	22580	**1560**	10.70	1.60
GU 18-400 	Per S	88.3	**69.3**	3290	**290**	6.10	0.65
	Per D	176.7	**138.7**	20870	**1430**	10.87	1.28
	Per T	265.0	**208.0**	28920	**1645**	10.45	1.92
	Per m of wall	220.8	**173.3**	26090	**1785**	10.87	1.60

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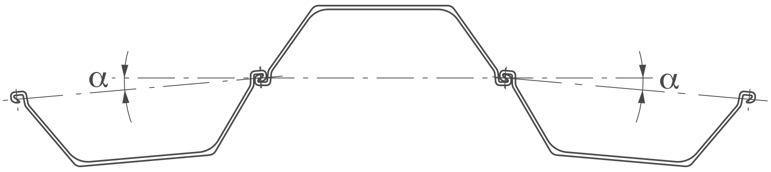
[1] One side, excluding inside of interlocks.

Interlock

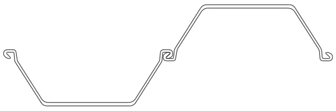
All AU™, PU® and GU® sheet piles feature Larssen interlocks in accordance with EN 10248. AU, PU and GU (except GU-400), as well as the AZ series, can be interlocked.
Theoretical interlock swing: $\alpha_{\text{max}} = 5°$



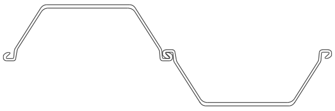
Delivery form

Single Pile

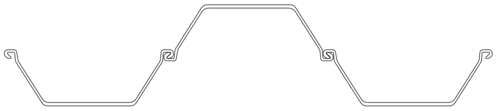
Double Pile
S-Form (standard)



Double Pile
Z-Form (on request)

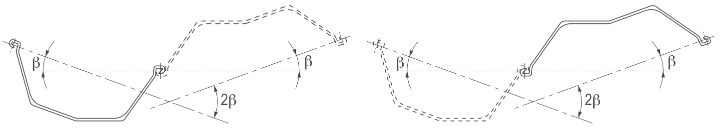


Triple Pile



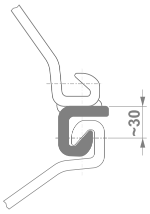
Bent piles

Maximum bending angle: β = 25°. U-piles are bent in the middle of the flange. They are generally delivered as single piles. Double piles are available upon request.

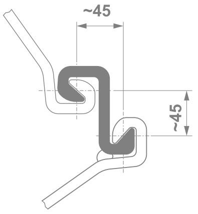


Corner sections

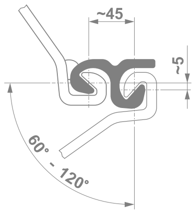
C 9
Mass ~ 9.3 kg/m
Coating area 0.15 m²/m



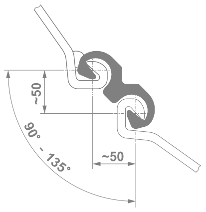
C 14
Mass ~ 14.4 kg/m
Coating area 0.22 m²/m



DELTA 13
Mass ~ 13.1 kg/m
Coating area 0.19 m²/m



OMEGA 18
Mass ~ 18.0 kg/m
Coating area 0.24 m²/m



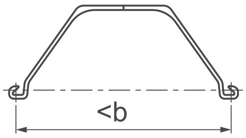
Special corner sections interlocking with U- and Z-sections make it possible to form corner or junction piles without using fabricated special piles. Corner sections are fixed to the sheet pile in accordance with EN 12063.

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

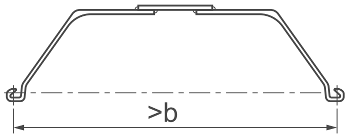
On request, arrangements can be made for widened or narrowed fabricated piles. The following special piles, among others, are available on request as single and double piles.

Narrowed pile



2501

Widened pile



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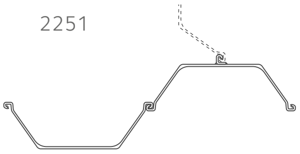
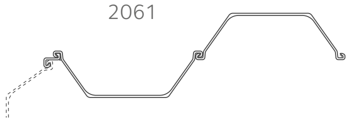
2251



2061



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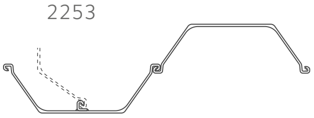
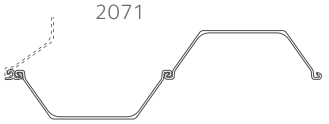


2071



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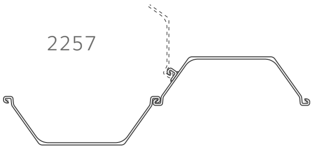

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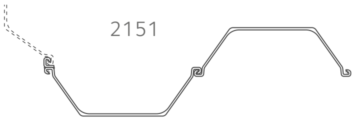
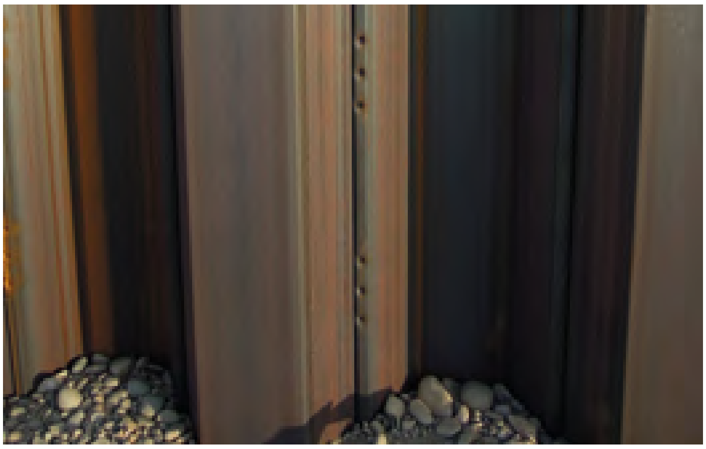


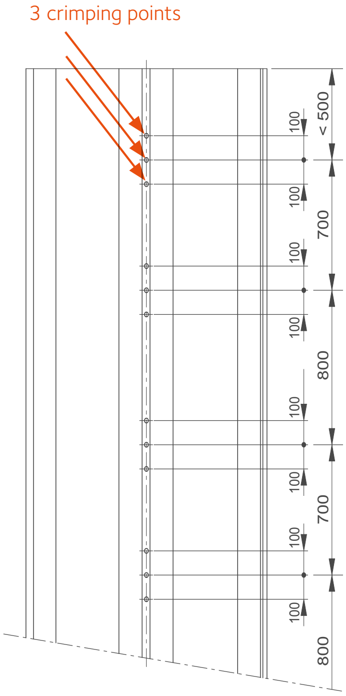
Crimping

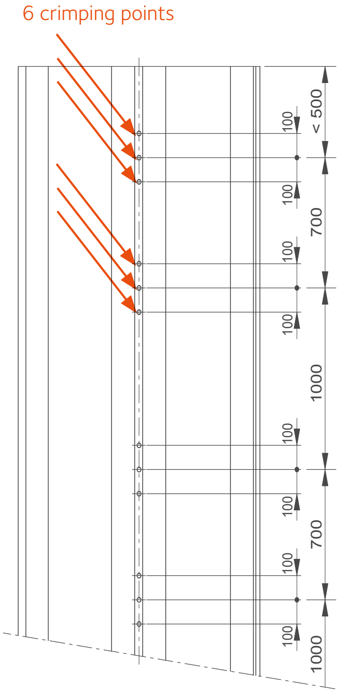
Contrary to Z-piles, the interlocks of U-piles have to transmit shear forces. To guarantee proper shear force transmission, ArcelorMittal's U-sections can be delivered as double piles with crimped interlocks.
See sketch for ArcelorMittal's standard crimping pattern. The allowable shear force per crimping point depends on the section and steel grade. **A resistance per crimp of minimum 75 kN at a displacement of up to 5 mm can be achieved**. The theoretical section properties of a continuous wall may have to be reduced even for double piles crimped[2].



AU standard crimping:
3 crimping points per 0.75 m
= 4 crimping points per m[1]

PU/GU standard crimping:
6 crimping points per 1.7 m
= 3.5 crimping points per m[1]





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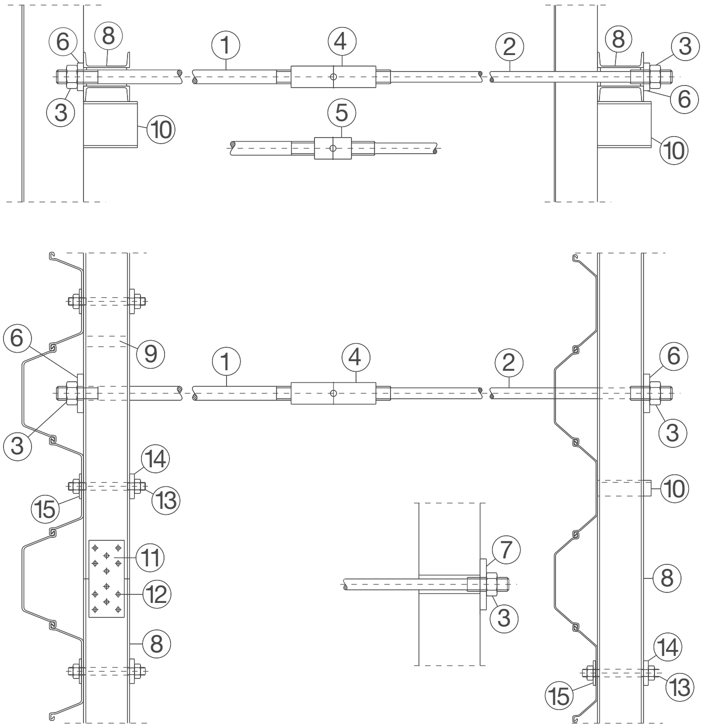
[1] Amount and layout of crimping points may differ at both ends. Special crimping on request.
[2] Based on EN1993-5. Please consult our Technical Department for more information.

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.

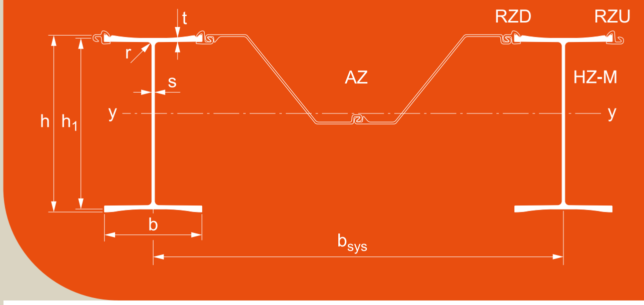


1 Plain tie-rod
2 Upset end tie-rod
3 Nut
4 Turnbuckle
5 Coupling sleeve
6 Bearing plate

7 Bearing plate on concrete
8 Waling
9 Spacer
10 Supporting bracket
11 Splicing plate

12 Splicing bolt
13 Fixing bolt
14 Fixing plate
15 Fixing plate

HZ® / AZ® combined wall system

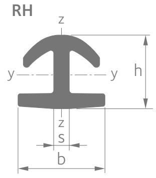


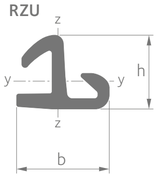
The HZ®-M combined wall is a revolutionary system, an extremely cost-effective combined wall solution launched in 2008 to replace the former HZ/AZ system, and consists of:
- HZ®-M king piles;
- a pair of AZ® sheet piles as intermediary elements;
- special connectors (RH, RZD, RZU).

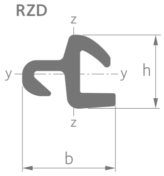
The HZ-M king piles, with milled grooves on the flanges and thicknesses up to 40 mm, fulfill two different structural functions:
- retaining members for soil and hydrostatic pressures;
- bearing piles for vertical loads.

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_x up to 46 500 cm^3/m)**.

Section (Sol. 102)	Dimensions							Torsional constant	Warping constant	Sectional area	Mass	Moment of inertia	Elastic section modulus	Coating area	Connector set
	h	h_1	b	t_{max}	t	s	r					y-y	y-y		
	mm	mm	mm	mm	mm	mm	mm	cm^4	10^{3}cm^6	cm^2	kg/m	cm^4	cm^3	m^2/m	
HZ 630M1)	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**		A
RZD 16	61.8		80.5							20.7	**16.2**	57	**18**		
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**		B
RZD 18	67.3		85.0							23.0	**18.0**	78	**22**		
RZU 18	67.3		85.0							22.6	**17.8**	92	**22**		







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1) Available upon request.

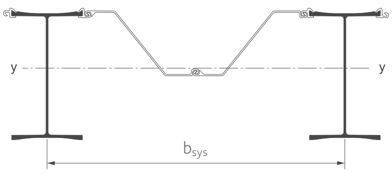
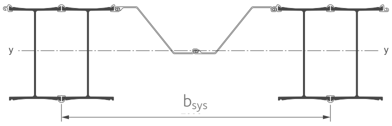
The outstanding feature of the HZ/AZ combined wall system is the extensive range of possible combinations using the entire AZ sheet pile offer, including the latest wide AZ-800 range, as well as all rolled-up and rolled-down AZ sections. The table below contains but a small sample of the available systems. **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:

2 connectors
1 RZD + 1RZU
↑
HZ 880M A – **1 2** / **AZ 25-800**
↓ ↓ ↓
King pile
1 king pile
HZ 880M A
Intermediary
AZ 25-800
double pile


Taipei Port, Taiwan


CT, JadeWeserPort, Germany

	Section	Sectional area cm^2/m	Moment of inertia cm^4/m	Elastic[1] section modulus cm^3/m	Elastic[2] section modulus cm^3/m	Mass[3] Mass$_{100}$ kg/m^2	Mass[3] Mass$_{60}$ kg/m^2	Coating area[4] Water side m^2/m
Combination HZ ... M - 12 / AZ 25-800	**HZ 630M**[5]	292.3	165710	**4870**	5455	229	184	2.70
	HZ 880M A	281.5	240530	**5385**	6150	221	176	2.73
	HZ 880M B	296.4	257290	**5790**	6510	233	188	2.74
	HZ 880M C	303.2	268670	**6040**	6770	238	193	2.74
	**HZ 1080M A**	316.0	418410	**7315**	8205	248	203	2.73
	HZ 1080M B	326.8	449000	**7850**	8755	257	212	2.73
	HZ 1080M C	346.3	485830	**8510**	9400	272	227	2.73
	HZ 1080M D	362.1	521780	**9120**	10045	284	240	2.73
b_{sys} = 2.127 m[6]	**HZ 1180M A**	374.7	548790	**9560**	10525	294	250	2.73
	HZ 1180M B	382.8	572490	**9970**	10935	300	256	2.74
	HZ 1180M C	398.4	607290	**10505**	11575	313	267	2.75
	HZ 1180M D	410.8	634670	**11015**	12010	322	277	2.75
Combination HZ ... M - 24 / AZ 25-800	**HZ 630M**[5]	377.5	236070	**7245**	6665	296	259	3.18
	HZ 880M A	357.5	356530	**8360**	7735	281	244	3.26
	HZ 880M B	381.6	382980	**8985**	8350	300	263	3.26
	HZ 880M C	392.7	401480	**9395**	8770	308	272	3.26
	**HZ 1080M A**	414.3	646970	**11760**	11065	325	289	3.25
	HZ 1080M B	431.8	695900	**12610**	11935	339	302	3.25
	HZ 1080M C	463.5	755430	**13670**	13005	364	327	3.26
b_{sys} = 2.598 m[7]	**HZ 1080M D**	489.3	813780	**14665**	14045	384	348	3.26
	HZ 1180M A	509.8	857500	**15370**	14825	400	364	3.26
	HZ 1180M B	522.1	893300	**15970**	15460	410	373	3.26
	HZ 1180M C	549.4	955970	**17010**	16445	431	394	3.28
	HZ 1180M D	567.7	994160	**17650**	17125	446	409	3.29

[1] Referring outside of HZ-M flange.
[2] Referring outside of RH / RZ.
[3] $L_{RH} = L_{HZ}$; $L_{RZU} = L_{RZD} = L_{AZ}$; Mass$_{100}$: L_{AZ} = 100% L_{HZ}; Mass$_{60}$: L_{AZ} = 60% L_{HZ}.
[4] Excluding inside of interlocks, per system width.
[5] Available upon request.
[6] For HZ 630M b_{sys} = 2.090 m
[7] For HZ 630M b_{sys} = 2.524 m

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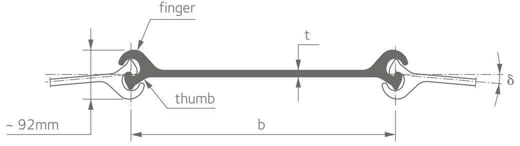
AS 500® straight web sections

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® Straight web steel sheet piles - design & execution manual" for further details.**

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

[1] The effective width to be taken into account for design purposes (layout) is 503 mm for all AS 500 sheet piles.
[2] Max. deviation angle 4.0° for pile length > 20 m.
[3] One side, excluding inside of interlocks.
[4] Please contact ArcelorMittal Sheet Piling for further information.



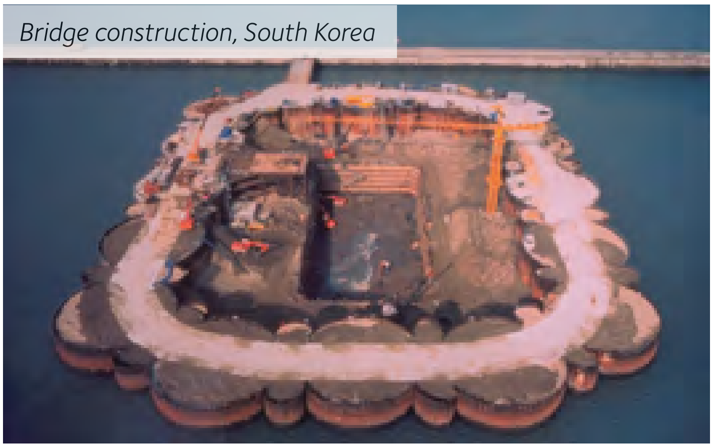

General cargo berth, Bal Haf, Yemen

The following characteristic interlock resistance can be guaranteed:

Section	$R_{k,s}$ [kN/m][5]
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

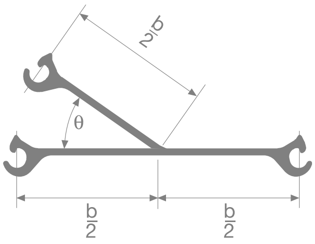
[5] For the related steel grade and further information, please contact ArcelorMittal Sheet Piling.

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° (4.0° if L > 20 m), bent piles can be used to set up structures with small radii.



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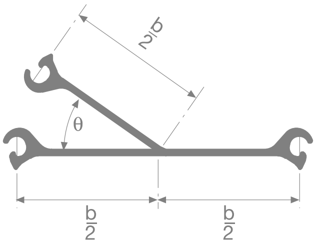

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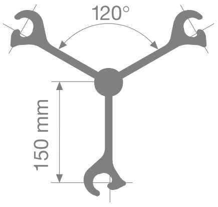

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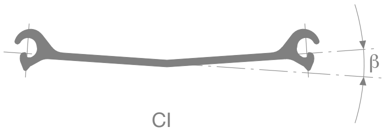

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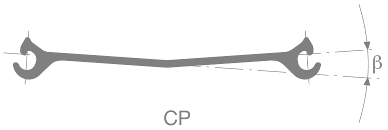
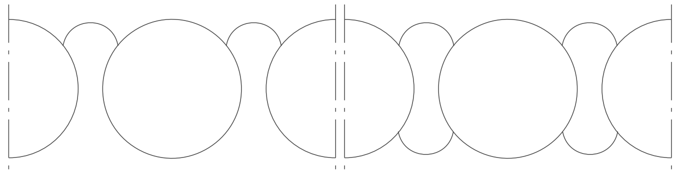
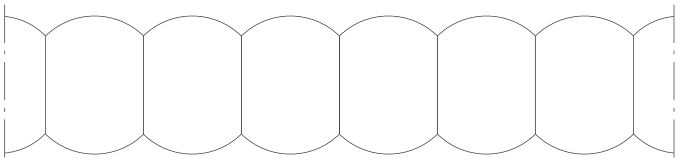


CP

Types of cells

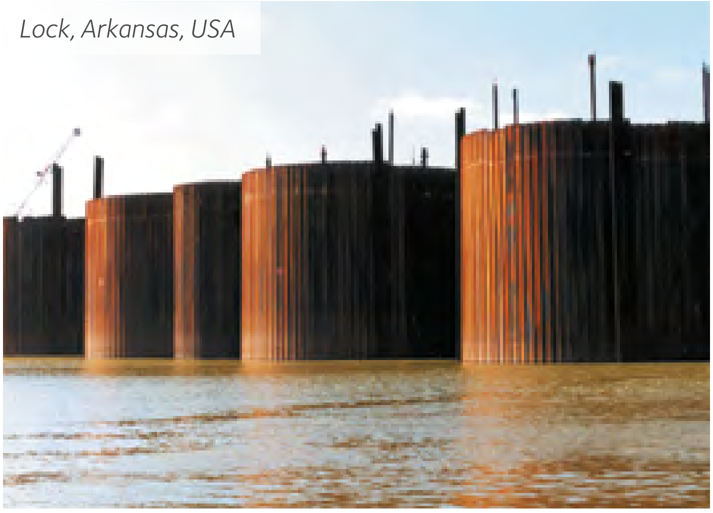


Circular cells with 35° junction piles and one or two connecting arcs.



Diaphragm cells with 120° junction piles.

Hissmofors, Sweden



Lock, Arkansas, USA

Circular cell construction

1. Installation of template

2. Threading until cell closure

3. 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:

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

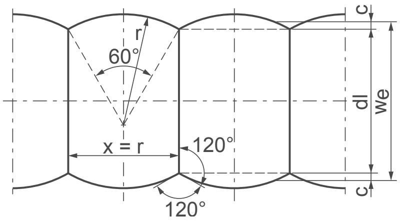
The ratio R_a indicates how economical the chosen circular cell will be.
It is defined as follows

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

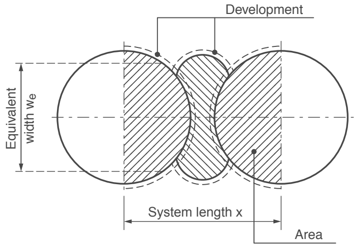
- **for diaphragm cells**

The equivalent width w_e is defined as:

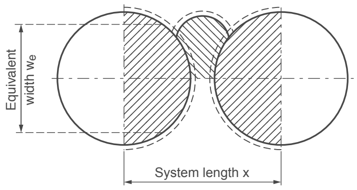
w_e = diaphragm wall length (dl) + 2 · c



circular cell with 2 arcs

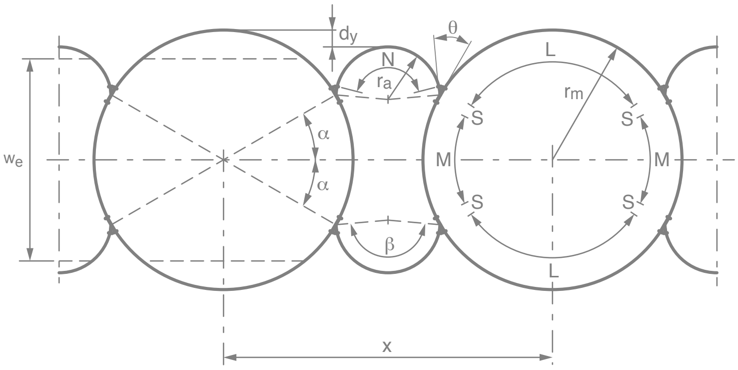


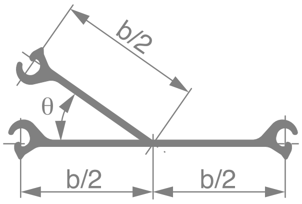
circular cell with 1 arc



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.





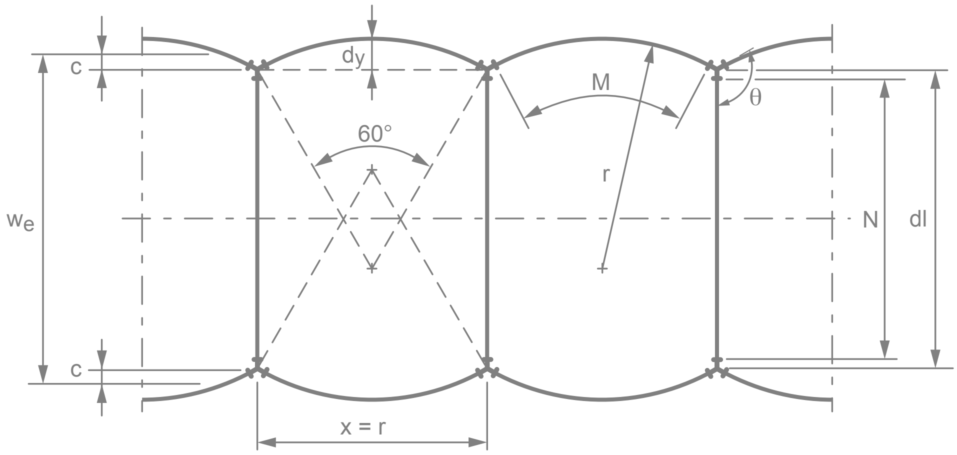
r_m = radius of the main cell
r_a = radius of the connecting arcs
θ = angle between the main cell and the connecting arc
x = system length
d_y = positive or negative offset between the connecting arcs and the tangent planes of the main cells
w_e = equivalent width

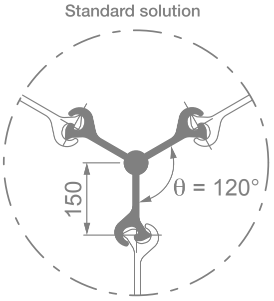
Junction piles with angles θ between 30° and 45°, as well as θ = 90°, are available on request.

The table below shows a short selection of circular cells with 2 arcs and standard junction piles with θ = 35°.

Nb. of piles per						Geometrical values						Interlock deviation		Design values	
Cell				Arc	System							Cell	Arc	2 Arcs	
Total pcs.	L pcs.	M pcs.	S pcs.	N pcs.	pcs.	$d = 2 \cdot r_m$ m	r_a m	x m	d_y m	α °	β °	δ_m °	δ_a °	w_e m	R_a
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

θ = 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

Tugboat berth, Panama Canal, Panama

Marina breakwater, Costa Rica

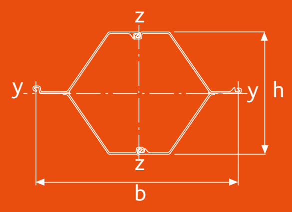
Geometry diaphragm wall

Number of piles N pcs.	Wall length dl 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

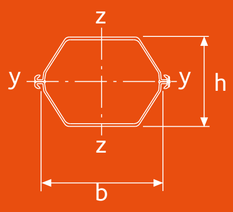
Geometry arc (Standard solution)

Number of piles M pcs.	Radius System length x = r m	Arc height d_y m	Equivalent arc height c m	Interlock deviation δ_a °
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

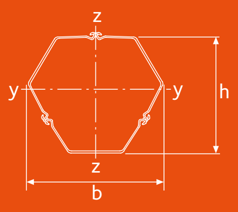
Box piles



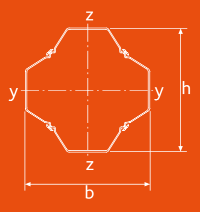
Z-box pile



Double U box pile



Triple U box pile



Quadruple U box pile

Section	Width	Height	Perimeter	Sectional area	Total section	Mass[1]	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area[2]
	b	h					y-y	z-z	y-y	z-z		
	mm	mm	cm	cm^2	cm^2	kg/m	cm^4	cm^4	cm^3	cm^3	cm	m^2/m
CAZ-800 box piles												
CAZ 18-800	1600	898	438	363	7340	**285**	339470	650340	**7535**	**7915**	30.6	4.16
CAZ 20-800	1600	900	438	400	7372	**314**	372430	713410	**8250**	**8690**	30.5	4.16
CAZ 22-800	1600	902	439	436	7404	**342**	405710	776690	**8965**	**9465**	30.5	4.16
CAZ 23-800	1600	948	445	423	7764	**332**	447370	756450	**9405**	**9170**	32.5	4.24
CAZ 25-800	1600	950	446	460	7796	**361**	484690	820800	**10170**	**9990**	32.5	4.24
CAZ 27-800	1600	952	446	497	7829	**390**	522220	885310	**10930**	**10750**	32.4	4.24
CAZ-750 box piles												
CAZ 28-750	1500	1018	445	453	7829	**356**	547100	702950	**10715**	**9080**	34.8	4.23
CAZ 30-750	1500	1020	446	490	7861	**385**	590180	758880	**11535**	**9840**	34.7	4.23
CAZ 32-750	1500	1022	446	527	7892	**414**	633500	815060	**12360**	**10535**	34.7	4.23
CAZ-700 and CAZ-770 box piles												
CAZ 12-770	1540	687	389	328	5431	**257**	175060	557990	**5075**	**6985**	23.1	3.67
CAZ 13-770	1540	688	389	344	5446	**270**	183440	584640	**5310**	**7320**	23.1	3.67
CAZ 14-770	1540	689	390	360	5461	**283**	191840	611300	**5545**	**7655**	23.1	3.67
CAZ 14-770 -10/10	1540	690	390	376	5476	**295**	200280	637960	**5780**	**7995**	23.1	3.67
CAZ 12-700	1400	628	360	303	4524	**238**	137770	421600	**4365**	**5785**	21.3	3.39
CAZ 13-700	1400	630	361	332	4552	**261**	150890	461210	**4765**	**6335**	21.3	3.39
CAZ 13-700-10/10	1400	631	361	347	4565	**272**	157530	481090	**4965**	**6610**	21.3	3.39
CAZ 14-700	1400	632	361	362	4579	**284**	164130	500820	**5165**	**6885**	21.3	3.39
CAZ 17-700	1400	839	391	330	6015	**259**	265280	457950	**6300**	**6285**	28.3	3.69
CAZ 18-700	1400	840	391	347	6029	**272**	277840	479790	**6590**	**6590**	28.3	3.69
CAZ 20-700	1400	842	392	379	6058	**297**	303090	523460	**7170**	**7195**	28.3	3.69
CAZ 24-700	1400	918	407	436	6616	**342**	412960	596900	**8965**	**8260**	30.8	3.85
CAZ 26-700	1400	920	407	469	6645	**368**	444300	641850	**9625**	**8900**	30.8	3.85
CAZ 28-700	1400	922	408	503	6674	**395**	475810	686880	**10285**	**9510**	30.8	3.85

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[1] The mass of the welds is not taken into account.
[2] Outside surface, excluding inside of interlocks.

Section	Width	Height	Perimeter	Sectional area	Total section	Mass[1]	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area[2]
	b	h					y-y	z-z	y-y	z-z		
	mm	mm	cm	cm^2	cm^2	kg/m	cm^4	cm^4	cm^3	cm^3	cm	m^2/m
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

[1] The mass of the welds is not taken into account.

[2] Outside surface, excluding inside of interlocks.

Wroclaw flood protection system, Poland

© Piotr Siemaszko

Section	Width	Height	Perimeter	Sectional area	Total section	Mass1)	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area2)
	b	h					y-y	z-z	y-y	z-z		
	mm	mm	cm	cm^2	cm^2	kg/m	cm^4	cm^4	cm^3	cm^3	cm	m^2/m
CAU double box piles												
CAU 14-2	750	451	230	198	2598	**155.8**	54400	121490	**2415**	**3095**	16.6	2.04
CAU 16-2	750	454	231	220	2620	**172.5**	62240	130380	**2745**	**3325**	16.8	2.04
CAU 18-2	750	486	239	225	2888	**177.0**	73770	142380	**3035**	**3625**	18.1	2.14
CAU 20-2	750	489	240	247	2910	**193.8**	83370	151220	**3405**	**3850**	18.4	2.14
CAU 23-2	750	492	244	260	3013	**204.2**	94540	157900	**3845**	**4020**	19.1	2.19
CAU 25-2	750	495	245	281	3034	**220.8**	104810	166600	**4235**	**4240**	19.3	2.19
CU double box piles												
CU 12-2	600	403	198	168	1850	**132.2**	34000	70000	**1685**	**2205**	14.2	1.72
CU 12S-2	600	405	198	181	1867	**142.1**	36120	76410	**1785**	**2410**	14.1	1.72
CU 18-2	600	473	212	196	2184	**153.8**	58020	78300	**2455**	**2470**	17.2	1.86
CU 22-2	600	494	220	219	2347	**172.3**	73740	88960	**2985**	**2800**	18.3	1.94
CU 28-2	600	499	226	259	2468	**203.6**	96000	103560	**3850**	**3260**	19.2	2.00
CU 32-2	600	499	223	291	2461	**228.3**	108800	109200	**4360**	**3435**	19.3	1.97
CGU double box piles												
CGU 7N-2	600	348	187	112	1596	**88.2**	16510	48530	**950**	**1535**	12.1	1.62
CGU 7S-2	600	349	188	118	1604	**92.5**	18210	50630	**1045**	**1605**	12.3	1.62
CGU 11N-2	600	359	193	153	1707	**120.4**	27670	60590	**1540**	**1915**	13.4	1.67
CGU 14N-2	600	461	205	164	2079	**128.6**	44070	65550	**1910**	**2075**	16.4	1.79
CGU 18N-2	600	473	212	196	2184	**153.8**	58020	78300	**2455**	**2470**	17.2	1.86
CGU 22N-2	600	494	220	219	2347	**172.3**	73740	88960	**2985**	**2800**	18.3	1.94
CGU 28N-2	600	499	226	259	2468	**203.6**	96000	103560	**3850**	**3260**	19.2	2.00
CGU 32N-2	600	499	223	291	2461	**228.3**	108800	109200	**4360**	**3435**	19.3	1.97
CGU 16-400-2	400	336	169	158	1170	**123.9**	25270	31900	**1505**	**1465**	12.7	1.40

1) The mass of the welds is not taken into account.
2) Outside surface, excluding inside of interlocks.

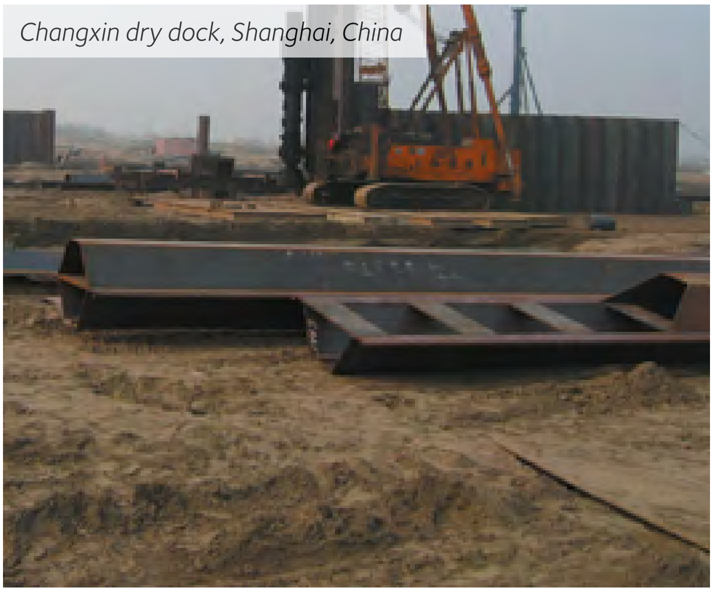
Section	Width	Height	Perimeter	Sectional area	Total section	Mass[1]	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area[2]
	b mm	h mm	cm	cm^2	cm^2	kg/m	y-y cm^4	z-z cm^4	y-y cm^3	z-z cm^3	cm	m^2/m
CAU triple box piles												
CAU 14-3	957	908	341	298	6454	**233.7**	300330		**6510**	**6275**	31.7	3.03
CAU 16-3	960	910	342	330	6486	**258.7**	333640		**7235**	**6955**	31.8	3.03
CAU 18-3	1009	927	355	338	6886	**265.5**	363690		**7825**	**7205**	32.8	3.17
CAU 20-3	1012	928	356	370	6919	**290.7**	399780		**8570**	**7900**	32.9	3.17
CAU 23-3	1036	930	361	390	7073	**306.3**	431940		**9235**	**8340**	33.3	3.24
CAU 25-3	1038	931	364	422	7106	**331.3**	469030		**9995**	**9035**	33.3	3.24
CU triple box piles												
CU 12-3	800	755	293	253	4431	**198.3**	173100		**4555**	**4325**	26.2	2.54
CU 12S-3	802	756	294	271	4457	**213.1**	186260		**4890**	**4645**	26.2	2.54
CU 18-3	877	790	315	294	4931	**230.7**	227330		**5475**	**5185**	27.8	2.76
CU 22-3	912	801	326	329	5174	**258.4**	268440		**6310**	**5890**	28.6	2.87
CU 28-3	938	817	336	389	5356	**305.4**	330290		**7720**	**7040**	29.1	2.96
CU 32-3	926	809	331	436	5345	**342.4**	367400		**8585**	**7935**	29.0	2.92
CGU triple box piles												
CGU 11N-3	781	730	285	230	4206	**180.7**	150670		**4040**	**3860**	25.6	2.47
CGU 14N-3	844	781	305	246	4763	**192.8**	182730		**4475**	**4330**	27.3	2.65
CGU 18N-3	877	790	315	294	4931	**230.7**	227330		**5475**	**5185**	27.8	2.76
CGU 22N-3	912	801	326	329	5174	**258.4**	268440		**6310**	**5890**	28.6	2.87
CGU 28N-3	938	817	336	389	5356	**305.4**	330290		**7720**	**7040**	29.1	2.96
CGU 32N-3	926	809	331	436	5345	**342.4**	367400		**8585**	**7935**	29.0	2.92

[1] The mass of the welds is not taken into account.
[2] Outside surface, excluding inside of interlocks.

Vilanova, Barcelona, Spain

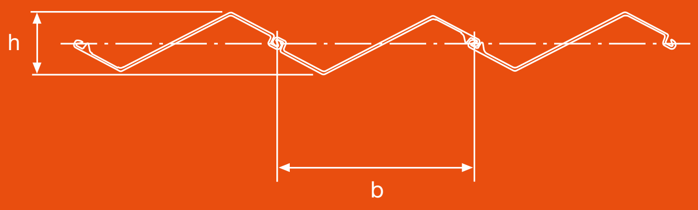
Section	Width	Height	Perimeter	Sectional area	Total section	Mass[1]	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area[2]
	b mm	h mm	cm	cm^2	cm^2	kg/m	y-y cm^4	z-z cm^4	y-y cm^3	z-z cm^3	cm	m^2/m
CAU quadruple box piles												
CAU 14-4	1222	1222	453	397	11150	**311.6**	692030		**11325**		41.7	4.02
CAU 16-4	1225	1225	454	440	11193	**345.0**	770370		**12575**		41.8	4.02
CAU 18-4	1258	1258	471	451	11728	**354.0**	826550		**13140**		42.8	4.20
CAU 20-4	1261	1261	472	494	11771	**387.6**	910010		**14430**		42.9	4.20
CAU 23-4	1263	1263	481	520	11977	**408.4**	979870		**15510**		43.4	4.30
CAU 25-4	1266	1266	482	563	12020	**441.6**	1064910		**16820**		43.5	4.30
CU quadruple box piles												
CU 12-4	1025	1025	388	337	7565	**264.4**	394000		**7690**		34.2	3.36
CU 12S-4	1027	1027	389	362	7598	**284.1**	423410		**8250**		34.2	3.36
CU 18-4	1095	1095	417	392	8231	**307.6**	507240		**9270**		36.0	3.65
CU 22-4	1115	1115	432	439	8556	**344.6**	593030		**10635**		36.8	3.80
CU 28-4	1120	1120	445	519	8799	**407.2**	725730		**12955**		37.4	3.93
CU 32-4	1120	1120	440	582	8782	**456.6**	811100		**14480**		37.3	3.87
CGU quadruple box piles												
CGU 11N-4	979	979	379	307	7254	**240.9**	347050		**7095**		33.6	3.27
CGU 14N-4	1081	1081	404	328	7997	**257.1**	409870		**7585**		35.4	3.51
CGU 18N-4	1095	1095	417	392	8231	**307.6**	507240		**9270**		36.0	3.65
CGU 22N-4	1115	1115	432	439	8556	**344.6**	593030		**10635**		36.8	3.80
CGU 28N-4	1120	1120	445	519	8799	**407.2**	725730		**12955**		37.4	3.93
CGU 32N-4	1120	1120	440	582	8782	**456.6**	811100		**14480**		37.3	3.87

[1] The mass of the welds is not taken into account.
[2] Outside surface, excluding inside of interlocks.


Changxin dry dock, Shanghai, China


Vilanova, Barcelona, Spain

Jagged wall



AZ® jagged wall: AZ® 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® jagged wall

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

1) One side, excluding inside of interlocks.

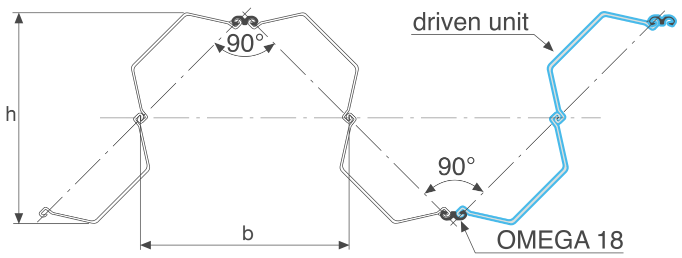
AZ® jagged wall

Section	Width	Height	Sectional area	Mass	Moment of inertia	Elastic section modulus	Coating area[1]
	b	h					
	mm	mm	cm^2/m	kg/m^2	cm^4/m	cm^3/m	m^2/m^2
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

[1] 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[1]		Elastic section modulus[1]		Static moment	
	b mm	h mm	kg/m^2	without Omega 18 cm^4/m	with Omega 18 cm^4/m	without Omega 18 cm^3/m	with Omega 18 cm^3/m	without Omega 18 cm^3/m	with Omega 18 cm^3/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

[1] 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®-M king piles / sheet piles;
- tubular king piles / sheet piles.

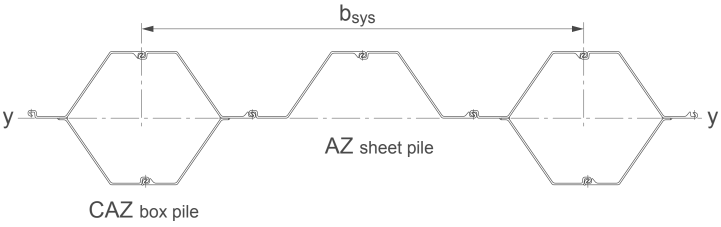
The primary piles or “king piles” of combined walls can also be used as bearing piles submitted to high vertical loads, e.g. crane loads. The intermediary sheet piles act mainly as soil-retaining and load-transferring elements.

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} [cm⁴/m]: Moment of inertia of combined wall

W_{sys} [cm³/m]: Elastic section modulus of combined wall

$I_{king\ pile}$ [cm⁴]: Moment of inertia of king pile

I_{ssp} [cm⁴]: Moment of inertia of intermediary sheet pile

$W_{king\ pile}$ [cm³]: Elastic section modulus of king pile

b_{sys} [m]: System width

CAZ box piles – AZ® sheet piles

Combination	System width b_{sys} mm	Mass$_{100}$[1] kg/m²	Mass$_{60}$[1] kg/m²	Moment of inertia I_{sys} cm⁴/m	Elastic section modulus W_{sys} cm³/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**

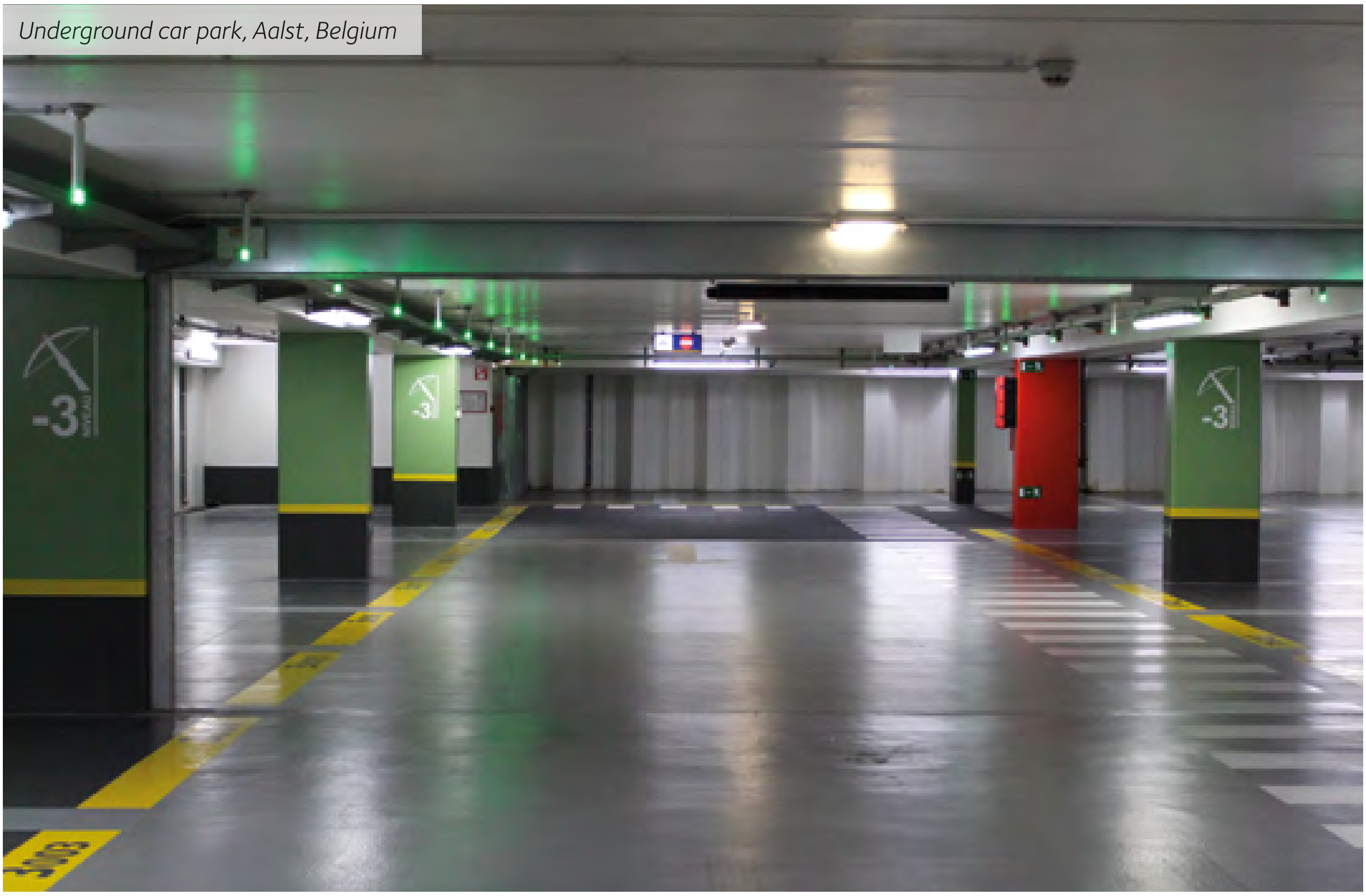
1) Mass$_{100}$: L_{AZ} = 100% $L_{box\ pile}$; Mass$_{60}$: L_{AZ} = 60% $L_{box\ pile}$.

CAZ box piles – AZ® sheet piles

Combination	System width b_{sys} mm	$Mass_{100}$ [1] kg/m²	$Mass_{60}$ [1] kg/m²	Moment of inertia I_{sys} cm⁴/m	Elastic section modulus W_{sys} cm³/m
AZ-700 and AZ-770					
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
AZ					
CAZ 18 / AZ 18	2520	163	139	105560	2765
CAZ 26 / AZ 18	2520	196	173	162660	3795

[1] $Mass_{100}$: L_{AZ} = 100% $L_{box\ pile}$; $Mass_{60}$: L_{AZ} = 60% $L_{box\ pile}$.

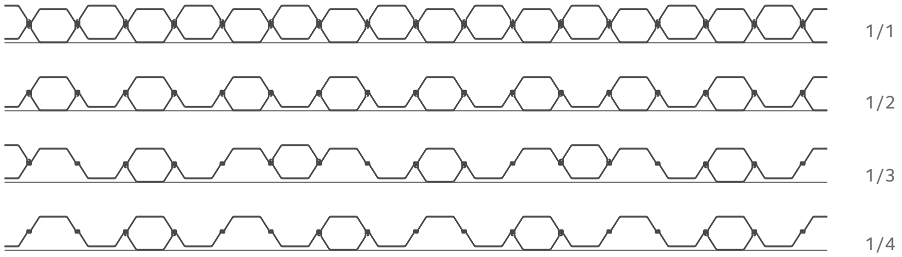
Underground car park, Aalst, Belgium



U box piles – U sheet piles

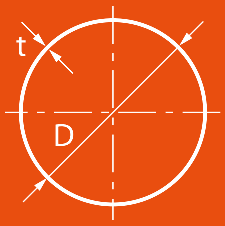
Type of reinforcement:
- Heightwise: full or partial height;
- Lengthwise: total length 1/1 or partial length 1/2, 1/3, 1/4.

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/m²	cm⁴/m	cm³/m	kg/m²	cm⁴/m	cm³/m	kg/m²	cm⁴/m	cm³/m	kg/m²	cm⁴/m	cm³/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[1]. 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 D mm	Thickness t mm	Moment of inertia I cm^4	Elastic section modulus W cm^3	Sectional area A cm^2	Mass G 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

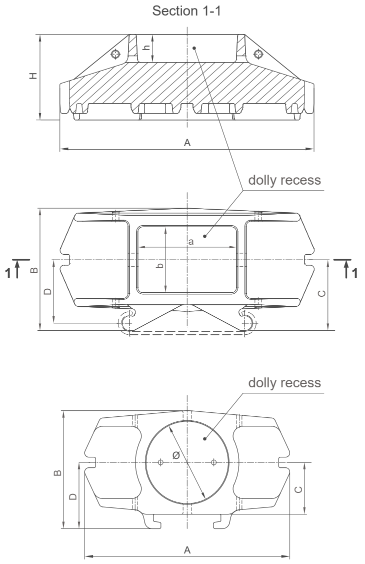
[1] Disclaimer: ArcelorMittal Sheet Piling highly recommends that Z or U sections used in tube combined walls as infill sheet piles are threaded with C9 connectors. Infill sheet piles threaded to C9 connectors are a proven solution with respect to optimum interlock fitting. In the event of use of a connector 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

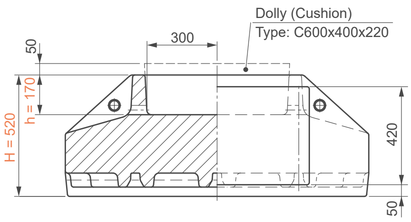
Driving caps	A	B	H	C	D	Mass	Dimensions of dolly recess	Corresponding sliding guide
	mm	mm	mm	mm	mm	kg	a/b/h or ø/h	
AUS 14-26	740	580	370	350	305	650	500/300/120	500/90
AUD 12-16	1540	750	520	430	385	1900	600/400/170	700/90
AUD 20-32	1570	750	520	430	385	2100	600/400/170	700/90
PUS	680	600	320	290	265	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
UD 2	1250	720	420	315	405	1250	ø 500/170	30
PUD 17-33	1250	720	420	315	405	1250	ø 500/170	30
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[1]	1510	702	400	420	375	1500	600/400/120	500/90
ZD 800 B-weld[1]	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



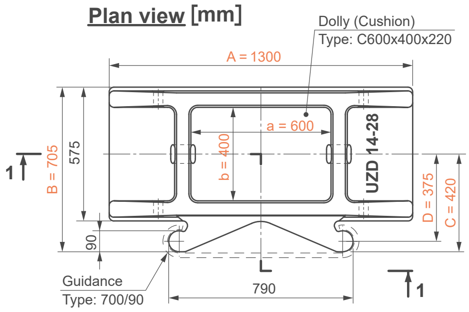
[1] Availability to be checked with technical department.

Driving caps – Examples

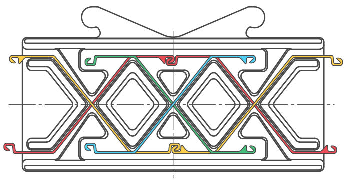
Section 1-1 (UZD 14-28) [mm]



Plan view [mm]

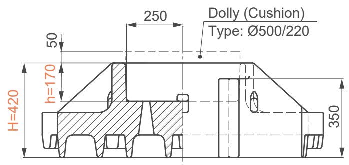


Bottom view

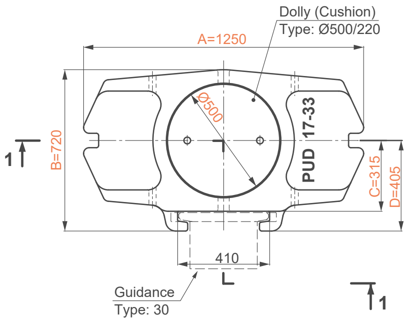


Position of section AZ 17-700... AZ 28-700 as single and double pile

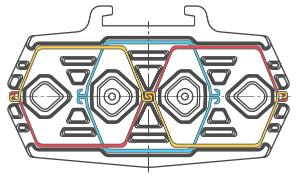
Section 1-1 (PUD 17-33) [mm]



Plan view [mm]



Bottom view



Position of section PU18...PU32 and GU13N...GU33N as single, double and box pile

Sheet pile sections and corresponding driving caps

Driving caps / Sections	AZD 12-14	AZD 12-14 L	UZD 14-28	AZD 36-40	A 18/26	ZD 800 A	ZD 800 B
Arrangement	D	D	D	D	D	D	D
AZ®-800							
AZ 18-800						✓	
AZ 20-800						✓	
AZ 22-800						✓	
AZ 23-800						✓	✓
AZ 25-800						✓	✓
AZ 27-800						✓	✓
AZ®-750							
AZ 28-750							✓
AZ 30-750							✓
AZ 32-750							✓
AZ®-700 and AZ®-770							
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				✓			
AZ®							
AZ 18					✓		
AZ 18-10/10					✓		
AZ 26					✓		

Driving caps / Sections	AUS 14-26	AUD 12-16	AUD 20-32	PUS	US-B	UD 1	UD 2	PUD 17-33	HS 8-11	HD 6-11
Arrangement	S	D/B	D/B	S	S	D/T/B	D/T/B	D/B	S	D
AU™										
AU 14	✓	✓								
AU 16	✓	✓								
AU 18	✓		✓							
AU 20	✓		✓							
AU 23	✓		✓							
AU 25	✓		✓		✓					
PU®										
PU 12				✓	✓	✓				
PU 12S				✓	✓	✓				
PU 18^{-1}				✓			✓	✓		
PU 18				✓			✓	✓		
PU 18^{+1}				✓			✓	✓		
PU 22^{-1}				✓			✓	✓		
PU 22				✓			✓	✓		
PU 22^{+1}				✓			✓	✓		
PU 28^{-1}				✓	✓			✓		
PU 28				✓	✓			✓		
PU 28^{+1}				✓	✓			✓		
PU 32^{-1}				✓	✓		✓	✓		
PU 32				✓	✓		✓	✓		
PU 32^{+1}				✓	✓		✓	✓		
GU®										
GU 6N				✓	✓	✓1)				
GU 7N				✓	✓	✓1)				
GU 7S				✓	✓	✓1)				
GU 7HWS				✓	✓	✓1)				
GU 8N				✓	✓	✓1)				
GU 8S				✓	✓	✓1)				
GU 10N						✓				
GU 11N						✓				
GU 12N						✓				
GU 13N				✓			✓	✓		
GU 14N				✓			✓	✓		
GU 15N				✓			✓	✓		
GU 16N				✓			✓	✓		
GU 18N				✓			✓	✓		
GU 20N				✓			✓	✓		
GU 21N				✓			✓	✓		
GU 22N				✓			✓	✓		
GU 23N				✓			✓	✓		
GU 27N				✓				✓		
GU 28N				✓				✓		
GU 30N				✓				✓		
GU 31N				✓	✓		✓	✓		
GU 32N				✓	✓		✓	✓		
GU 33N				✓	✓		✓	✓		
HZ®-M										
HZ 630M									✓2)	✓2)
HZ 880M									✓	✓
HZ 1080M									✓	✓
HZ 1180M									✓	✓

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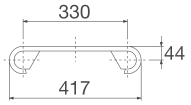
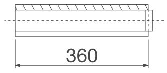
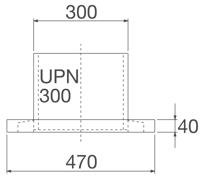
1) Not fitting for box piles.
2) On request.

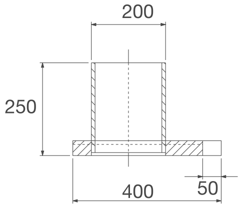
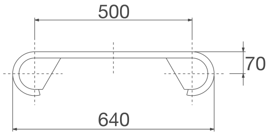
S = Single pile
D = Double pile
T = Triple pile
B = Box pile

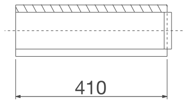
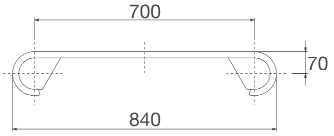
Sliding guides

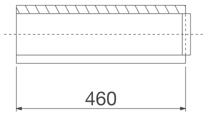
Sliding guides are designed to guide the driving cap along the leader, thus guaranteeing proper alignment of the hammer in the centre of the driving cap. Their adaptation to the leader is normally carried out on-site.

<table>
<tr><th>Dimensions</th><th>Designation</th><th>Corresponding driving caps</th></tr>
<tr><td>

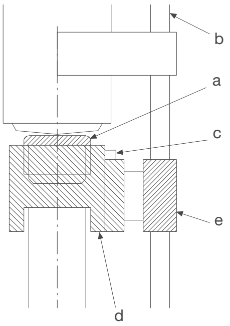

</td><td>330/50</td><td>PUS
US-B</td></tr>
<tr><td>

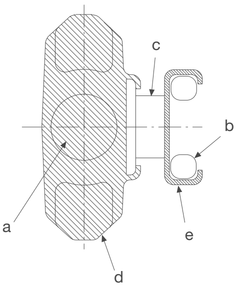

</td><td>30</td><td>UD
PUD</td></tr>
<tr><td>


</td><td>500/90</td><td>A
AUS
ZD 800 A-weld
ZD 800 B-weld
HS 8-11</td></tr>
<tr><td>


</td><td>700/90</td><td>AUD
AZD
ZD 800 A
ZD 800 B
UZD
HD 6-11</td></tr>
</table>

Arrangement of driving caps





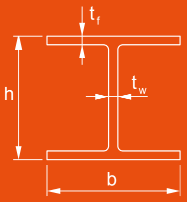
a = dolly/cushion
b = leader
c = sliding guide
d = driving cap
e = leader slide

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;
- 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.



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.

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	Dimensions				Sectional area	Total area $A_{tot} = h \cdot b$	Perimeter	Moment of inertia		Elastic section modulus	
		h	b	t_w	t_f				y-y	z-z	y-y	z-z
	kg/m	mm	mm	mm	mm	cm^2	cm^2	m	cm^4	cm^4	cm^3	cm^3
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

$t_w = t_{web}$ = web thickness

$t_f = t_{flange}$ = flange thickness


Deurganckdock CT, Antwerp, Belgium

Durability of steel sheet piles

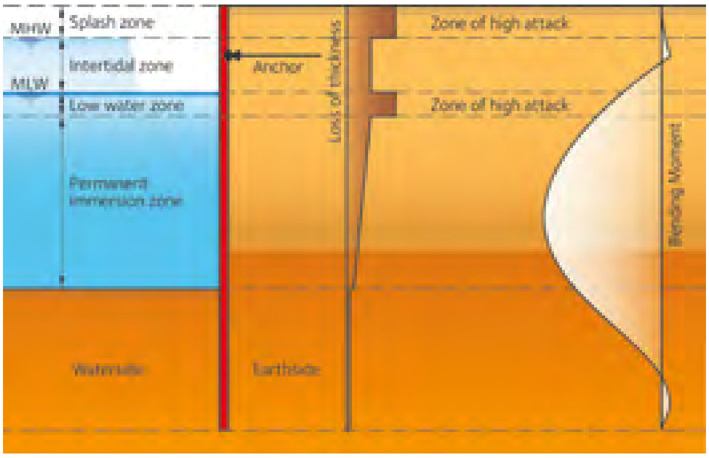
Unprotected steel in the atmosphere, water or soil is subject to corrosion that may lead to damage. Local weakening and rusting-through are normally considered to be maintenance problems that can be remedied locally. Depending on life-time requirements and accessibility to the structure, the service 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 µm

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 µm

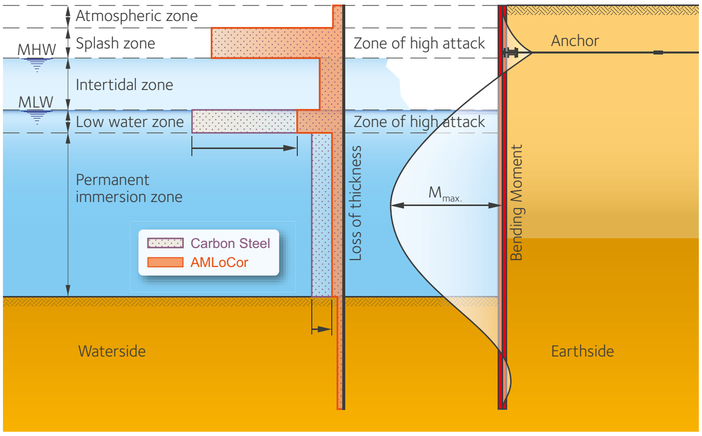
Waste disposal, Horn, Austria

AMLoCor®

New 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.

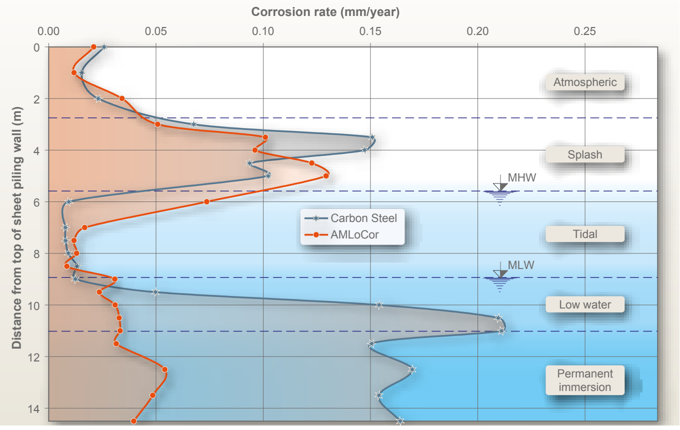


Typical loss of steel thickness in a marine environment: regular carbon steel vs. AMLoCor®.

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.



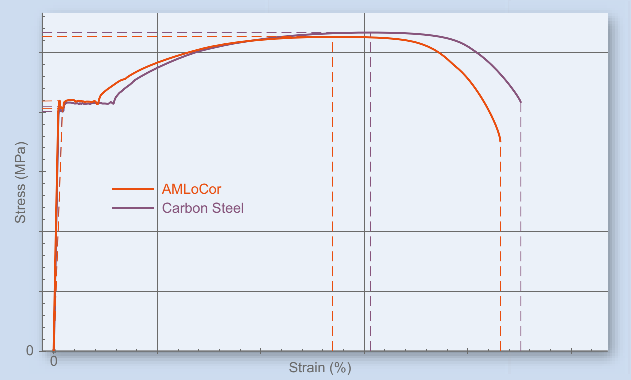
Steel grades AMLoCor are covered by the German National Technical Approval Z-30.10-55 of the "Deutsche Institut für Bautechnik (DIBt)".

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).

$$\boxed{q(z) = \rho \cdot \Delta p(z) / \gamma_W}$$

$q(z)$	water discharge [m³/s/m]
ρ	inverse joint resistance [m/s]
$\Delta p(z)$	pressure drop at level z [kPa]
γ_W	unit weight of water [kN/m³]

Sealing system/method	ρ [10^{-10} m/s]			Application of the system	Cost ratio[1]
	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

[1] Cost ratio = $\dfrac{\text{Cost of sealing system}}{\text{Cost of Beltan® Plus Solution}}$

[2] After excavation for the interlock to be threaded on jobsite.

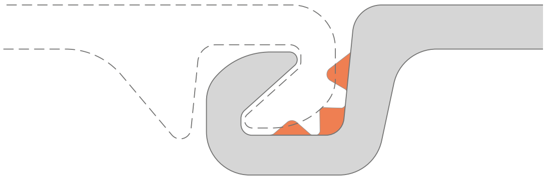
Excavation for an office building, Amsterdam, The Netherlands

AKILA® sealing system

AKILA® 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/cm³ for MSP-1;
  - 1.48 g/cm³ 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).



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® 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.).

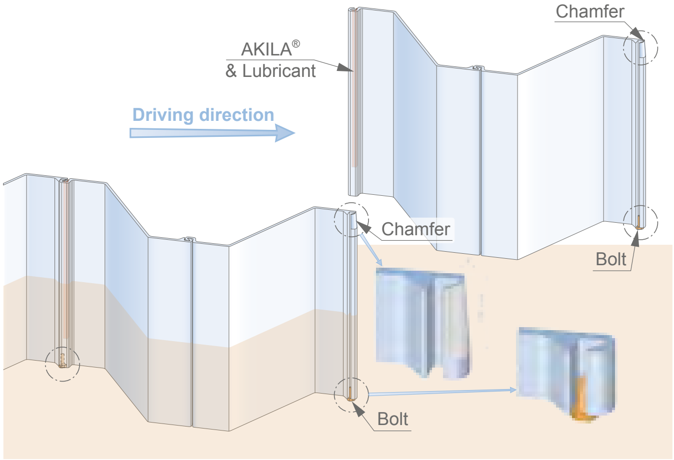
Inverse joint resistance ρ_m

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® 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 ρ_m** was determined according to EN 12063, see table below.

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



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

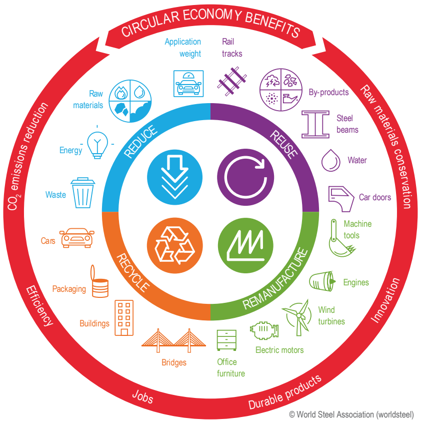
ArcelorMittal's brand values are health & safety, sustainability, quality and leadership. As a global leading steel producer, we aim at reaching carbon neutrality by 2050.

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.

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.

Circular economy

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, …



© World Steel Association (worldsteel)

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 BES 6001. 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.

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 one of the four EPDs registered at the *Institut Bauen und Umwelt e.V.* (IBU), Germany, in accordance with the current European standards, and accepted by the ECO PLATFORM.

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

ArcelorMittal's EPDs are 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: sorting and shredding of after-use steel, non-recovered scrap due to sorting efficiency;
- D: End-of-Life scenarios, including reuse and recycling.

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 20th century that are still in use.

ArcelorMittal has published 4 EPDs since 2016. The declared unit is always 1 tonne of steel sheet piles.

1. The generic ***"Hot rolled steel sheet piling"*** EPD was published in 2016 and covers hot rolled steel sheet piles (AZ®, AU™, PU®, GU®, AS 500® and HZ®-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™"*** EPD was published in 2018 and covers hot rolled steel sheet piles (AZ®, AU™, PU®, AS 500® and HZ®-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 covers cold formed steel sheet piles (PAZ™, PAL™, PAU™ 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™ Plus"*** EPD was published in 2021 and covers hot rolled steel sheet piles (AZ®, AU™, PU®, AS 500® and HZ®-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.

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

(reduced tolerances on request)

Tolerances	AU™, PU®, GU®	AZ®	AS 500®	HZ®-M
Mass[1]	± 5%	± 5%	± 5%	± 5%
Length (L)	± 200 mm	± 200 mm	± 200 mm	± 200 mm
Height (h)[2]	h ≤ 200 mm: ± 4 mm h > 200 mm: ± 5 mm	h ≥ 300 mm: ± 7 mm	-	h ≥ 500 mm: ± 7 mm
Thicknesses (t,s)	t, s ≤ 8.5 mm: ± 0.5 mm t, s > 8.5 mm: ± 6%	t, s ≤ 8.5 mm: ± 0.5 mm t, s > 8.5 mm: ± 6%	t > 8.5 mm: ± 6%	t, s > 12.5 mm: –1.5 mm / +2.5 mm
Width single pile (b)	± 2% b	± 2% b	± 2% b	± 2% b
Width double pile (2b)	± 3% (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% b

[1] From the mass of the total delivery. [2] Of single pile.

Maximum rolling lengths (longer sections available on request)

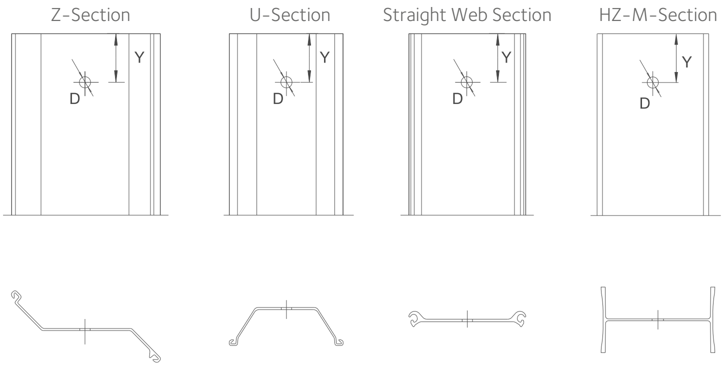
Section	AZ	AU, PU	GU[1]	AS 500	HZ-M	RH / RZ	OMEGA 18	C9 / C14	DELTA 13
Length [m]	31	31	28	31	33	24	16	18	17

[1] Contact us for detailed information.

Handling holes

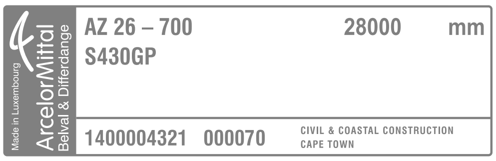
Sheet pile sections are normally supplied without handling holes. If requested, they can be provided with handling holes in the centreline of the section. The standard handling hole dimensions are as follows:

Diameter D [mm]	40	40	40	50	50	63.5
Distance Y [mm]	75	150	300	200	250	230



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.



Made in Luxembourg
ArcelorMittal
Belval & Differdange

AZ 26 – 700 28000 mm
S430GP

1400004321 000070
CIVIL & COASTAL CONSTRUCTION
CAPE TOWN

Steel grades of sheet pile sections

Steel grade EN 10248	Min. yield strength R_{eH}	Min. tensile strength R_m	Min. elongation $L_o=5.65\sqrt{S_o}$	Chemical composition[1] (% max)					
	MPa	MPa	%	C	Mn	Si	P	S	N[2), 3)]
S 240 GP	**240**	340	26	0.25	–	–	0.055	0.055	0.011
S 270 GP	**270**	410	24	0.27	–	–	0.055	0.055	0.011
S 320 GP	**320**	440	23	0.27	1.70	0.60	0.055	0.055	0.011
S 355 GP	**355**	480	22	0.27	1.70	0.60	0.055	0.055	0.011
S 390 GP	**390**	490	20	0.27	1.70	0.60	0.050	0.050	0.011
S 430 GP	**430**	510	19	0.27	1.70	0.60	0.050	0.050	0.011
ArcelorMittal mill specification									
S 460 AP	**460**	550	17	0.27	1.70	0.60	0.050	0.050	0.011

AMLoCor®	Min. yield strength R_{eH}	Min. tensile strength R_m	Min. elongation $L_o=5.65\sqrt{S_o}$	Chemical composition[1] (% weight)							
				(% max.)						(% min.)	
	MPa	MPa	%	C	Mn	Si	P	S	N[2), 3)]	Cr	Al
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

All the sections can be delivered in steel grades according to EN 10248-1, but not all sections are available in all steel grades. Below table summarizes the current possibilities. Special steel grades like **S 460 AP**, 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 Chapter 10.4 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	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 AP
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	-	-

	EN 10248							ASTM	
Steel Grade / Section	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 AP	A 572	A 690
AZ-700 to 800	✓[4]	✓	✓	✓	✓	✓	✓	✓	✓
AZ	✓[4]	✓	✓	✓	✓	✓	✓	✓	✓[4]
AU	✓[4]	✓	✓	✓	✓	✓	✓	✓	✓
PU	✓[4,5]	✓[5]	✓[5]	✓	✓	✓[6]	✓[6]	✓	✓[6]
GU-N/S	✓[4]	✓	✓	✓	✓	✓	✓[7]	❖	✗
GU-400	✓[4]	✓	✓	✓	✓	❖	❖	❖	✗
HZ-M	✓[4]	✓	✓	✓	✓	✓	✓	✓	✓
RH / RZD / RZU	✗	✗	✗	✗	✗	✓	✓	✗	✓
C 9	✗	✗	✗	✓	✗	✗	✗	✓	✗
C 14	✗	✗	✗	✓	✗	✗	✗	✗	✗
Delta 13	✗	✗	✗	✓	✗	✗	✗	✗	✗
Omega 18	✗	✗	✗	✗	✗	✓	✓	✗	✗

	AMLoCor®		
	Blue 320	Blue 355	Blue 390
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	✗	✓	✗

[1] Product analysis. Maximum copper content of 0.6% for non-alloyed steel.

[2] It is permissible to exceed the specific values provided that for each increase of 0.001% N, the P max content will be reduced by 0.005%. However, the N content shall not exceed 0.012% on the ladle analysis and 0.014% on the product analysis.

[3] The maximum value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0.020% or if sufficient other N binding elements are present.

[4] Please contact us as some limitations may apply.

[5] Except PU 12 & derivatives.

[6] PU 12 & derivatives on request.

[7] GU 11N & derivatives on request.

✓ Available.
❖ On request.
✗ Currently unavailable.

Geometric tolerances of tubular piles

Tolerance on pile length: ± 200 mm

Standard	Outside diameter D	Wall thickness t	Straightness	Out-of-roundness	Mass	Maximum weld bead height[1]
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

[1] 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) MPa	Min. yield strength R_{eH} ($16 < t \leq 40$ mm) MPa	Min. tensile strength R_m ($3 \leq t \leq 40$ mm) MPa	Min. elongation L_o ($t \leq 40$ mm) %	Chemical composition (% max)						
					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[1] ISO 3183	Min. yield strength R_{eH} MPa	Min. tensile strength R_m MPa	Min. elongation[2] %	Chemical composition for pipe with t ≤ 25.0 mm[4] (% max)			
				C[3]	Mn[3]	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[5]	1.40[5]	0.030	0.030
L 450 or **X 65**	**450**	535	18	0.26[5]	1.45[5]	0.030	0.030
L 485 or **X 70**	**485**	570	17	0.26[5]	1.65[5]	0.030	0.030

[1] API 5L (2018): American Petroleum Institute. PSL 1 (Product Specification Level 1): Composition according to specification.

[2] Minimum elongation: depends on tensile test piece cross-sectional area.

[3] 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.

[4] 0.50 % max for Cu, 0.50 % max for Ni, 0.50 % max for Cr, 0.15 % max for Mb.

[5] Unless otherwise agreed.

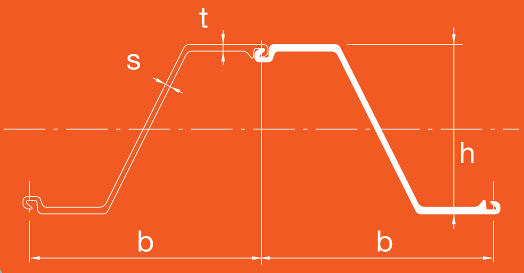
Tubular pile mill, Dintelmond, The Netherlands

Contents - Imperial edition


New ferry pier built with HZ®-M combined wall, port of Calais, France

© Calais Port 2015

Z-Sections



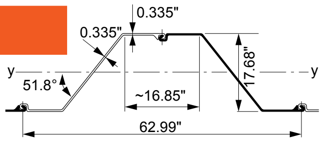
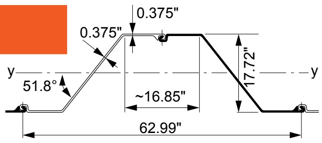
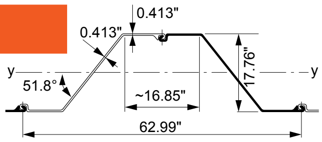
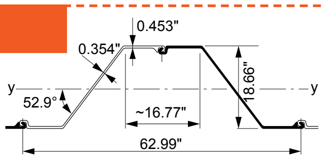
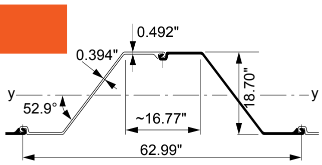
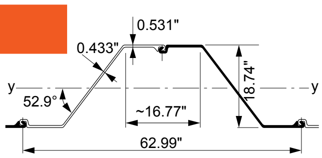
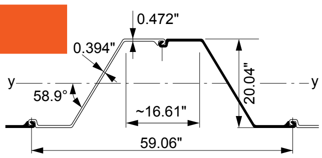
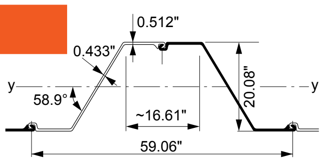
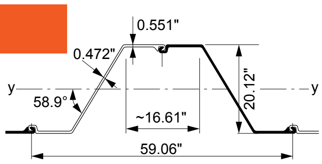
The essential characteristics of Z-sections include the continuous form of the web and the location of the interlock symmetrically on each side of the neutral axis. Both aspects create a positive influence on the section modulus. The AZ® series. a section with extraordinary characteristics and the proven qualities of the Larssen interlock, has the following advantages:

- extremely competitive section-modulus-to-mass ratio;
- increased inertia for reduced deflection;
- large width, resulting in competitive installation performance;
- good corrosion resistance, the steel being thickest at the critical corrosion points.

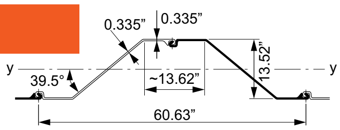
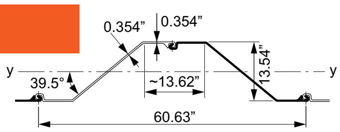
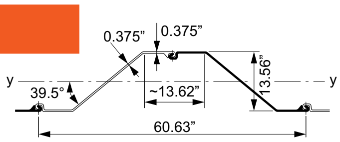
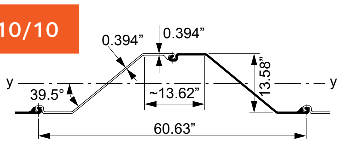
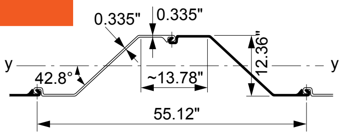
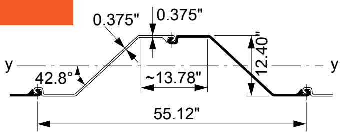
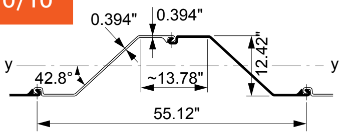
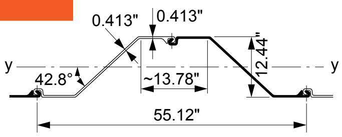
Section	Width	Height	Thickness		Sectional area	Mass		Moment of inertia	Elastic section modulus	Static moment	Plastic section modulus	Class1)						
	b in	h in	t in	s in	in^2/ft	single pile lb/ft	wall lb/ft^2	in^4/ft	in^3/ft	in^3/ft	in^3/ft	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 AP
AZ®-800																		
AZ 18-800	31.50	17.68	0.335	0.335	6.07	54.26	**20.67**	302.6	**34.2**	19.8	39.7	3	3	3	3	3	4	4
AZ 20-800	31.50	17.72	0.375	0.375	6.66	59.50	**22.67**	329.9	**37.2**	21.7	43.3	3	3	3	3	3	3	3
AZ 22-800	31.50	17.76	0.413	0.413	7.25	64.77	**24.68**	357.3	**40.2**	23.5	47.0	2	2	3	3	3	3	3
AZ 23-800	31.50	18.66	0.453	0.354	7.12	63.56	**24.22**	404.6	**43.4**	24.9	49.8	2	2	2	3	3	3	3
AZ 25-800	31.50	18.70	0.492	0.394	7.71	68.91	**26.26**	435.1	**46.5**	26.9	53.8	2	2	2	2	2	3	3
AZ 27-800	31.50	18.74	0.531	0.433	8.31	74.26	**28.29**	465.6	**49.7**	28.8	57.7	2	2	2	2	2	2	2
AZ®-750																		
AZ 28-750	29.53	20.04	0.472	0.394	8.09	67.73	**27.53**	523.9	**52.3**	30.2	60.4	2	2	2	2	3	3	3
AZ 30-750	29.53	20.08	0.512	0.433	8.73	73.08	**29.70**	561.5	**55.9**	32.4	64.8	2	2	2	2	2	2	3
AZ 32-750	29.53	20.12	0.551	0.472	9.37	78.44	**31.88**	599.0	**59.6**	34.6	69.2	2	2	2	2	2	2	2
AZ®-700 and AZ®-770																		
AZ 12-770	30.32	13.54	0.335	0.335	5.68	48.79	**19.31**	156.9	**23.2**	13.8	27.5	2	2	3	3	3	3	3
AZ 13-770	30.32	13.54	0.354	0.354	5.95	51.11	**20.23**	163.8	**24.2**	14.4	28.8	2	2	3	3	3	3	3
AZ 14-770	30.32	13.58	0.375	0.375	6.22	53.44	**21.15**	170.6	**25.2**	15.0	30.0	2	2	2	2	3	3	3
AZ 14-770-10/10	30.32	13.58	0.394	0.394	6.48	55.70	**22.05**	177.5	**26.1**	15.6	31.2	2	2	2	2	2	3	3
AZ 12-700	27.56	12.36	0.335	0.335	5.82	45.49	**19.81**	138.3	**22.4**	13.2	26.3	2	2	3	3	3	3	3
AZ 13-700	27.56	12.40	0.375	0.375	6.36	49.72	**21.65**	150.4	**24.3**	14.3	28.6	2	2	2	3	3	3	3
AZ 13-700-10/10	27.56	12.42	0.394	0.394	6.63	51.85	**22.58**	156.5	**25.2**	14.9	29.8	2	2	2	2	3	3	3
AZ 14-700	27.56	12.44	0.413	0.413	6.90	53.96	**23.50**	162.5	**26.1**	15.5	31.0	2	2	2	2	2	3	3
AZ 17-700	27.56	16.52	0.335	0.335	6.29	49.14	**21.40**	265.3	**32.2**	18.9	37.7	2	2	3	3	3	3	3
AZ 18-700	27.56	16.54	0.354	0.354	6.58	51.47	**22.38**	276.8	**33.5**	19.7	39.4	2	2	3	3	3	3	3
AZ 19-700	27.56	16.56	0.375	0.375	6.88	53.79	**23.42**	288.4	**34.8**	20.6	41.0	2	2	2	3	3	3	3
AZ 20-700	27.56	16.57	0.394	0.394	7.18	56.11	**24.43**	299.9	**36.2**	21.4	42.7	2	2	2	2	2	3	3
AZ 24-700	27.56	18.07	0.441	0.441	8.23	64.30	**28.00**	408.8	**45.2**	26.7	53.3	2	2	2	2	2	2	3
AZ 26-700	27.56	18.11	0.480	0.480	8.84	69.12	**30.10**	437.3	**48.4**	28.6	57.1	2	2	2	2	2	2	2
AZ 28-700	27.56	18.15	0.520	0.520	9.46	73.93	**32.19**	465.9	**51.3**	30.5	60.9	2	2	2	2	2	2	2

Section	Width	Height	Thickness		Sectional area	Mass		Moment of inertia	Elastic section modulus	Static moment	Plastic section modulus	Class[1]						
	b in	h in	t in	s in	in^2/ft	single pile lb/ft	wall lb/ft^2	in^4/ft	in^3/ft	in^3/ft	in^3/ft	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 AP
AZ®-700 and AZ®-770																		
AZ 36-700N	27.56	19.65	0.591	0.441	10.20	79.72	**34.71**	656.2	**66.8**	38.2	76.4	2	2	2	2	2	2	2
AZ 38-700N	27.56	19.69	0.630	0.480	10.87	84.94	**36.98**	694.5	**70.6**	40.5	81.1	2	2	2	2	2	2	2
AZ 40-700N	27.56	19.72	0.669	0.520	11.54	90.16	**39.26**	732.9	**74.3**	42.8	85.7	2	2	2	2	2	2	2
AZ 42-700N	27.56	19.65	0.709	0.551	12.22	95.51	**41.59**	768.4	**78.2**	45.2	90.3	2	2	2	2	2	2	2
AZ 44-700N	27.56	19.69	0.748	0.591	12.89	100.74	**43.87**	806.6	**82.0**	47.5	95.0	2	2	2	2	2	2	2
AZ 46-700N	27.56	19.72	0.787	0.630	13.56	105.97	**46.14**	844.9	**85.7**	49.8	99.5	2	2	2	2	2	2	2
AZ 48-700	27.56	19.80	0.866	0.591	13.63	106.49	**46.37**	876.2	**88.5**	51.0	102.1	2	2	2	2	2	2	2
AZ 50-700	27.56	19.84	0.906	0.630	14.30	111.73	**48.65**	914.6	**92.2**	53.3	106.7	2	2	2	2	2	2	2
AZ 52-700	27.56	19.88	0.945	0.669	14.97	116.97	**50.93**	953.0	**95.9**	55.7	111.3	2	2	2	2	2	2	2
AZ®																		
AZ 18[2]	24.80	14.96	0.375	0.375	7.11	50.01	**24.19**	250.4	**33.5**	19.5	39.1	2	2	2	3	3	3	3
AZ 18-10/10	24.80	15.00	0.394	0.394	7.43	52.27	**25.29**	260.3	**34.8**	20.4	40.7	2	2	2	2	3	3	3
AZ 26[2]	24.80	16.81	0.512	0.480	9.34	65.73	**31.80**	406.5	**48.4**	28.5	56.9	2	2	2	2	2	2	2

[1] Classification according to EN 1993-5. Class 1 is obtained by verification of the rotation capacity for a class-2 cross-section.
[2] Can be rolled-up or rolled-down by 19.7 mils and 39.4 mils on request.
A set of tables with all the data required for design in accordance with EN 1993-5 is available from our Technical Department.
Tailor made profiles can be rolled on request.

Section	S = Single pile D = Double pile	Sectional area in^2	Mass lb/ft	Moment of inertia in^4	Elastic section modulus in^3	Radius of gyration in	Coating area[1)] ft^2/ft
AZ®-800							
AZ 18-800 	Per S	15.94	**54.26**	794.2	**89.9**	7.06	3.41
	Per D	31.89	**108.52**	1 588.3	**179.7**	7.06	6.82
	Per ft of wall	6.07	**20.67**	302.6	**34.2**	7.06	1.30
AZ 20-800 	Per S	17.48	**59.50**	865.8	**97.7**	7.04	3.41
	Per D	34.97	**119.01**	1 731.5	**195.5**	7.04	6.82
	Per ft of wall	6.66	**22.67**	329.9	**37.2**	7.04	1.30
AZ 22-800 	Per S	19.03	**64.77**	937.8	**105.6**	7.02	3.41
	Per D	38.06	**129.53**	1 875.5	**211.3**	7.02	6.83
	Per ft of wall	7.25	**24.68**	357.3	**40.2**	7.02	1.30
AZ 23-800 	Per S	18.68	**63.56**	1 061.9	**113.8**	7.54	3.46
	Per D	37.35	**127.12**	2 124.0	**227.6**	7.54	6.93
	Per ft of wall	7.12	**24.22**	404.6	**43.4**	7.54	1.32
AZ 25-800 	Per S	20.25	**68.91**	1 141.9	**122.0**	7.51	3.47
	Per D	40.50	**137.82**	2 283.9	**244.3**	7.51	6.94
	Per ft of wall	7.71	**26.26**	435.1	**46.5**	7.51	1.32
AZ 27-800 	Per S	21.82	**74.26**	1 221.9	**130.4**	7.48	3.47
	Per D	43.64	**148.53**	2 443.8	**260.8**	7.48	6.94
	Per ft of wall	8.31	**28.29**	465.6	**49.7**	7.48	1.32
AZ®-750							
AZ 28-750 	Per S	19.90	**67.73**	1 289.1	**128.7**	8.05	3.46
	Per D	39.80	**135.46**	2 578.1	**257.3**	8.05	6.93
	Per ft of wall	8.09	**27.53**	523.9	**52.3**	8.05	1.41
AZ 30-750 	Per S	21.48	**73.08**	1 381.5	**137.6**	8.02	3.47
	Per D	42.95	**146.17**	2 763.0	**275.2**	8.02	6.93
	Per ft of wall	8.73	**29.70**	561.5	**55.9**	8.02	1.41
AZ 32-750 	Per S	23.05	**78.44**	1 474.0	**146.4**	8.00	3.47
	Per D	46.10	**156.88**	2 948.0	**293.1**	8.00	6.93
	Per ft of wall	9.37	**31.88**	599.0	**59.6**	8.00	1.41

[1)] 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[1]
		in^2	lb/ft	in^4	in^3	in	ft^2/ft
AZ®-700 and AZ®-770							
AZ 12-770 	Per S	14.34	**48.79**	396.4	**58.5**	5.26	3.03
	Per D	28.68	**97.59**	792.8	**117.1**	5.26	6.05
	Per ft of wall	5.68	**19.31**	156.9	**23.2**	5.26	1.20
AZ 13-770 	Per S	15.02	**51.11**	413.7	**61.1**	5.25	3.03
	Per D	30.04	**102.23**	827.4	**122.2**	5.25	6.05
	Per ft of wall	5.95	**20.23**	163.8	**24.2**	5.25	1.20
AZ 14-770 	Per S	15.70	**53.44**	431.0	**63.4**	5.24	3.03
	Per D	31.40	**106.87**	862.2	**127.0**	5.24	6.05
	Per ft of wall	6.22	**21.15**	170.6	**25.2**	5.24	1.20
AZ 14-770-10/10 	Per S	16.37	**55.70**	448.5	**65.8**	5.23	3.03
	Per D	32.74	**111.41**	896.9	**132.1**	5.23	6.05
	Per ft of wall	6.48	**22.05**	177.5	**26.1**	5.23	1.20
AZ 12-700 	Per S	13.37	**45.49**	317.6	**51.2**	4.87	2.81
	Per D	26.73	**90.97**	635.2	**102.8**	4.87	5.61
	Per ft of wall	5.82	**19.81**	138.3	**22.4**	4.87	1.22
AZ 13-700 	Per S	14.61	**49.72**	345.4	**55.7**	4.86	2.81
	Per D	29.22	**99.45**	690.7	**111.4**	4.86	5.61
	Per ft of wall	6.36	**21.65**	150.4	**24.3**	4.86	1.22
AZ 13-700-10/10 	Per S	15.24	**51.85**	359.3	**57.7**	4.86	2.81
	Per D	30.47	**103.71**	718.7	**115.7**	4.86	5.61
	Per ft of wall	6.63	**22.58**	156.5	**25.2**	4.86	1.22
AZ 14-700 	Per S	15.86	**53.96**	373.2	**59.8**	4.85	2.81
	Per D	31.71	**107.93**	746.3	**120.0**	4.85	5.61
	Per ft of wall	6.90	**23.50**	162.5	**26.1**	4.85	1.22

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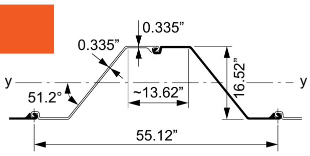
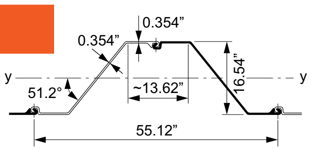
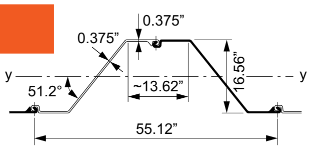
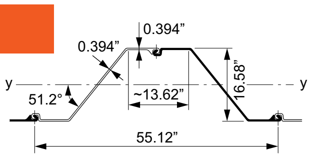
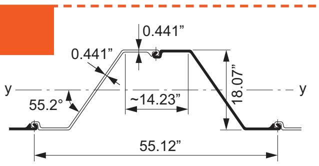
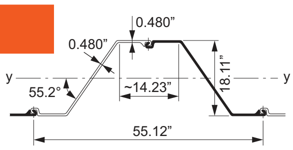
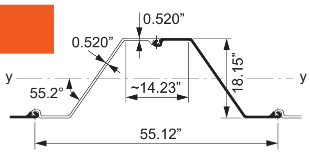
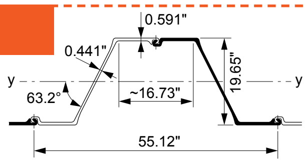
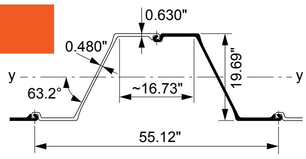
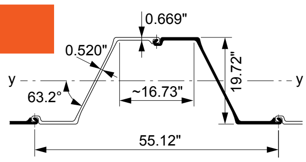
[1] One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area[1]
		in^2	lb/ft	in^4	in^3	in	ft^2/ft
AZ®-700 and AZ®-770							
AZ 17-700 	Per S	14.44	**49.14**	609.3	**73.8**	6.50	3.05
	Per D	28.88	**98.29**	1 218.5	**147.6**	6.50	6.10
	Per ft of wall	6.29	**21.40**	265.3	**32.2**	6.50	1.33
AZ 18-700 	Per S	15.12	**51.47**	635.7	**76.9**	6.48	3.05
	Per D	30.21	**102.81**	1 271.4	**153.8**	6.48	6.10
	Per ft of wall	6.58	**22.38**	276.8	**33.5**	6.48	1.33
AZ 19-700 	Per S	15.81	**53.79**	662.4	**79.9**	6.47	3.05
	Per D	31.61	**107.58**	1 324.5	**160.0**	6.47	6.10
	Per ft of wall	6.88	**23.42**	288.4	**34.8**	6.47	1.33
AZ 20-700 	Per S	16.49	**56.11**	688.8	**82.9**	6.46	3.05
	Per D	32.98	**112.22**	1 377.6	**166.2**	6.46	6.10
	Per ft of wall	7.18	**24.43**	299.9	**36.2**	6.46	1.33
AZ 24-700 	Per S	18.90	**64.30**	938.8	**103.8**	7.05	3.17
	Per D	37.79	**128.61**	1 877.6	**207.8**	7.05	6.33
	Per ft of wall	8.23	**28.00**	408.8	**45.2**	7.05	1.38
AZ 26-700 	Per S	20.31	**69.12**	1 004.3	**110.9**	7.03	3.17
	Per D	40.62	**138.24**	2 008.7	**221.8**	7.03	6.33
	Per ft of wall	8.84	**30.10**	437.3	**48.4**	7.03	1.38
AZ 28-700 	Per S	21.73	**73.93**	1 070.0	**117.8**	7.02	3.17
	Per D	43.45	**147.87**	2 139.9	**235.8**	7.02	6.33
	Per ft of wall	9.46	**32.19**	465.9	**51.3**	7.02	1.38
AZ 36-700N 	Per S	23.42	79.72	1 507.0	153.2	8.02	3.36
	Per D	46.85	159.43	3 014.0	306.8	8.02	6.73
	Per ft of wall	10.20	34.71	656.2	66.8	8.02	1.47
AZ 38-700N 	Per S	24.96	**84.94**	1 595.0	**161.9**	7.99	3.36
	Per D	49.92	**169.88**	3 190.0	**324.1**	7.99	6.73
	Per ft of wall	10.87	**36.98**	694.5	**70.6**	7.99	1.47
AZ 40-700N 	Per S	26.49	**90.16**	1 683.1	**170.6**	7.97	3.36
	Per D	52.99	**180.32**	3 366.2	**341.3**	7.97	6.73
	Per ft of wall	11.54	**39.26**	732.9	**74.3**	7.97	1.47

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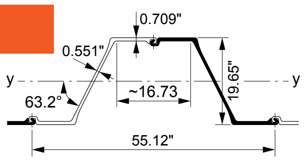
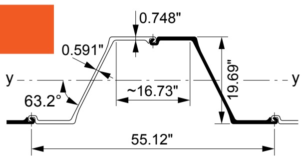
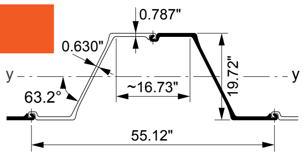
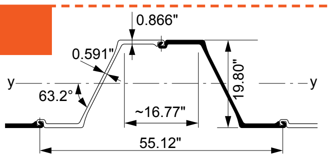
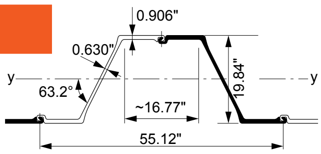
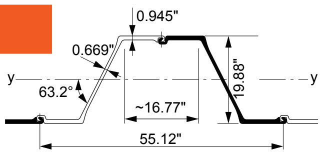
[1] One side, excluding inside of interlocks.

Section	S = Single pile D = Double pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area[1]
		in²	lb/ft	in⁴	in³	in	ft²/ft
AZ®-700 and AZ®-770							
AZ 42-700N 	Per S	28.07	**95.51**	1 764.7	**179.6**	7.93	3.36
	Per D	56.13	**191.03**	3 529.3	**359.3**	7.93	6.72
	Per ft of wall	12.22	**41.59**	768.4	**78.2**	7.93	1.46
AZ 44-700N 	Per S	29.60	**100.74**	1 852.4	**188.2**	7.91	3.36
	Per D	59.20	**201.48**	3 704.8	**376.4**	7.91	6.72
	Per ft of wall	12.89	**43.87**	806.6	**82.0**	7.91	1.46
AZ 46-700N 	Per S	31.14	**105.97**	1 940.2	**196.6**	7.89	3.36
	Per D	62.28	**211.95**	3 880.5	**393.5**	7.89	6.72
	Per ft of wall	13.56	**46.14**	844.9	**85.7**	7.89	1.46
AZ 48-700 	Per S	31.29	**106.49**	2 012.2	**203.1**	8.02	3.35
	Per D	62.58	**212.98**	4 024.4	**406.4**	8.02	6.69
	Per ft of wall	13.63	**46.37**	876.2	**88.5**	8.02	1.46
AZ 50-700 	Per S	32.83	**111.73**	2 100.4	**211.6**	8.00	3.35
	Per D	65.66	**223.46**	4 200.8	**423.4**	8.00	6.70
	Per ft of wall	14.30	**48.65**	914.6	**92.2**	8.00	1.46
AZ 52-700 	Per S	34.37	**116.97**	2 188.7	**220.2**	7.98	3.35
	Per D	68.74	**233.93**	4 377.3	**440.3**	7.98	6.70
	Per ft of wall	14.97	**50.93**	953.0	**95.9**	7.98	1.46

[1] One side, excluding inside of interlocks.

Coastal defense project, Colwyn Bay, UK

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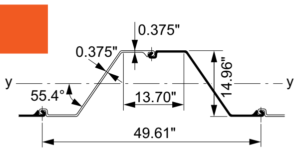
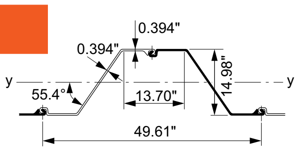
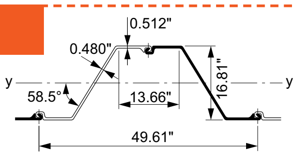
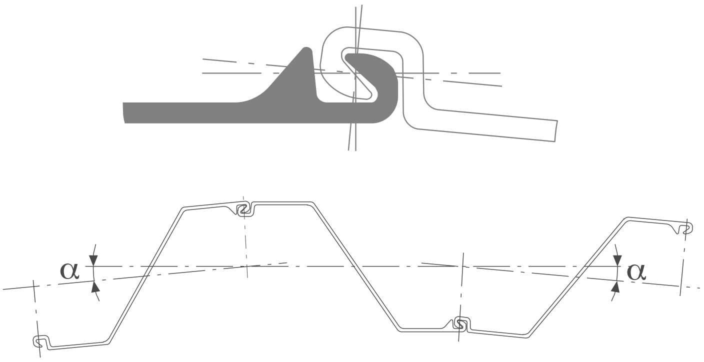
Section		S = Single pile D = Double pile	Sectional area	Mass	Moment of inertia	Elastic section modulus	Radius of gyration	Coating area[1]
			in²	lb/ft	in⁴	in³	in	ft²/ft
AZ®								
AZ 18		Per S	14.69	**50.01**	517.5	**69.2**	5.93	2.82
		Per D	29.39	**100.01**	1 035.1	**138.4**	5.93	5.61
		Per ft of wall	7.11	**24.19**	250.4	**33.5**	5.93	1.35
AZ 18-10/10		Per S	15.36	**52.27**	537.9	**71.7**	5.92	2.82
		Per D	30.72	**104.55**	1 076.1	**143.7**	5.92	5.61
		Per ft of wall	7.43	**25.29**	260.3	**34.8**	5.92	1.35
AZ 26		Per S	19.31	**65.73**	840.2	**100.0**	6.60	2.95
		Per D	38.63	**131.45**	1 680.3	**199.9**	6.60	5.84
		Per ft of wall	9.34	**31.80**	406.5	**48.4**	6.60	1.41

[1] One side, excluding inside of interlocks.

Boardwalk, Aarschot, Belgium

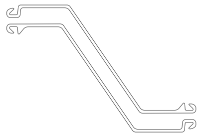
Interlock



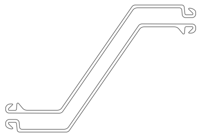
AZ® Larssen interlock in accordance with EN 10248.
All available AZ sheet piles can be interlocked.
Theoretical interlock swing: $\alpha_{max} = 5°$.

Delivery form

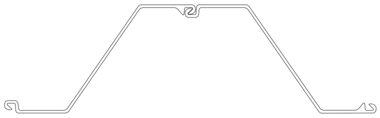
Single Pile
Position A



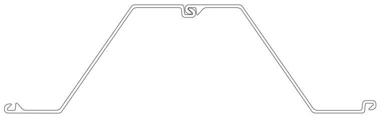
Single Pile
Position B



Double Pile
Form I (standard)

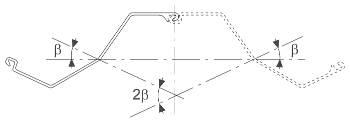


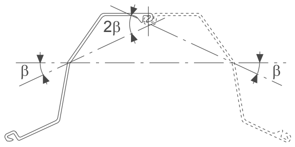
Double Pile
Form II (on request)



Bent piles

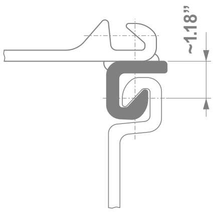
Maximum bending angle: β = 25°. Z-piles are usually bent in the middle of the web. They are generally delivered as single piles. Double piles are available upon request.



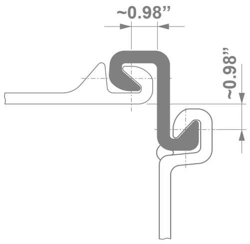


Corner sections

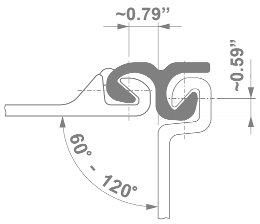
C 9
Mass ~ 6.25 lb/ft
Coating area 0.49 ft²/ft



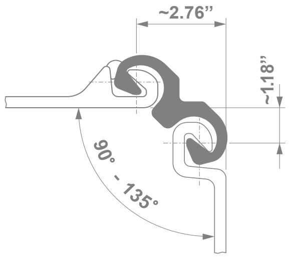
C 14
Mass ~ 9.68 lb/ft
Coating area 0.72 ft²/ft



DELTA 13
Mass ~ 8.80 lb/ft
Coating area 0.62 ft²/ft



OMEGA 18
Mass ~ 12.10 lb/ft
Coating area 0.79 ft²/ft

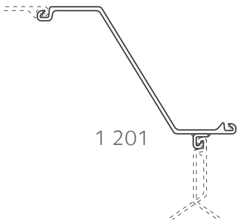


Special corner sections interlocking with Z-sections make it possible to form corner or junction piles without using fabricated special piles. Corner sections are fixed to the sheet pile in accordance with EN 12063.

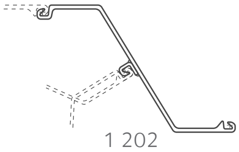
Different welding specifications are available on request. The corner sections are threaded and welded with usually a 8" setback from the top of the piles.

Corner and junction piles

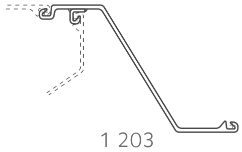
The following special piles, among others, are available as single and double piles on request.



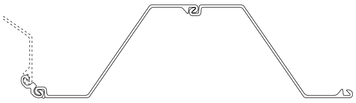
1 201



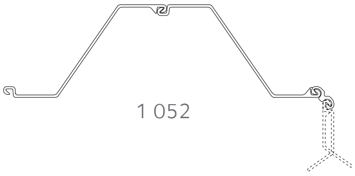
1 202



1 203

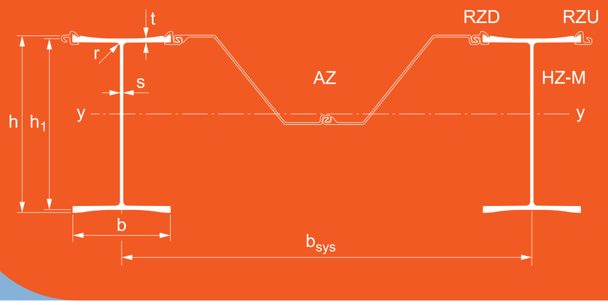


1 051



1 052

HZ® / AZ® combined wall system



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

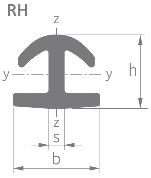
The HZ-M king piles, with milled grooves on the flanges and thicknesses up to 1.6", fulfill two different structural functions:

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

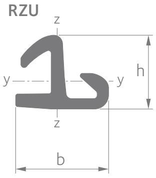
The combinations are based on the same principle: structural supports comprising 1 or 2 HZ-M king pile sections alternating with or without intermediary double AZ sheet pile sections. The intermediary sheet piles have a soil-retaining and load-transferring function and are generally shorter than the HZ-M king piles. Depending on the combinations and steel grades adopted, the achievable bending moment capacity lies above 4720 kips.ft/ft **(W$_x$ up to 865 in^3/ft)**.

Section (Sol. 102)	Dimensions							Torsional constant	Warping constant	Sectional area	Mass	Moment of inertia	Elastic section modulus	Coating area	Connector set
	h	h$_1$	b	t$_{max}$	t	s	r					y-y	y-y		
	in	in	in	in	in	in	in	in^4	10^3 in^6	in^2	lb/ft	in^4	in^3	ft^2/ft	
HZ 630M[1]	24.86	24.24	16.54	1.141	0.953	0.630	1.18	13.7	105.81	47.83	**162.77**	5 224.5	**426.2**	9.42	A
HZ 880M A	32.73	31.63	18.03	1.141	0.743	0.512	1.18	9.0	218.22	45.97	**156.46**	8 583.7	**536.9**	11.24	A
HZ 880M B	32.73	31.79	18.11	1.141	0.823	0.591	1.18	11.8	234.61	50.98	**173.51**	9 435.9	**587.4**	11.26	A
HZ 880M C	32.73	31.94	18.11	1.141	0.902	0.591	1.18	13.7	245.37	53.23	**181.14**	10 012.9	**620.5**	11.26	A
HZ 1080M A	42.33	41.24	17.87	1.141	0.773	0.630	1.18	12.6	367.05	57.15	**194.49**	16 590.8	**797.8**	12.72	A
HZ 1080M B	42.33	41.47	17.87	1.141	0.891	0.630	1.18	15.8	397.56	60.72	**206.63**	18 134.7	**866.8**	12.72	A
HZ 1080M C	42.33	41.71	17.95	1.141	1.011	0.709	1.18	21.0	426.44	67.23	**228.79**	20 018.9	**952.3**	12.73	A
HZ 1080M D	42.33	42.02	17.99	1.207	1.170	0.748	1.18	27.1	450.52	72.50	**246.73**	21 854.4	**1032.5**	12.74	A
HZ 1180M A	42.34	-	18.03	1.364	1.221	0.787	1.18	32.5	464.17	76.72	**261.08**	23 238.6	**1090.1**	12.74	A
HZ 1180M B	42.50	-	18.03	1.443	1.300	0.787	1.18	37.1	493.10	79.37	**270.13**	24 433.5	**1139.7**	12.78	A
HZ 1180M C	42.65	-	18.07	1.522	1.379	0.827	1.18	43.7	530.88	83.89	**285.51**	25 972.6	**1207.6**	12.81	B
HZ 1180M D	42.81	-	18.11	1.600	1.458	0.866	1.18	50.7	558.54	88.05	**299.66**	27 355.6	**1262.5**	12.86	B
Connectors															
RH 16	2.43	-	2.69			0.48				3.12	**10.62**	2.0	**1.5**		A
RZD 16	2.43	-	3.19							3.21	**10.89**	1.4	**1.1**		
RZU 16	2.43	-	3.19							3.16	**10.82**	1.6	**1.1**		
RH 20	2.65	-	3.12			0.56				3.91	**13.44**	3.0	**3.0**		B
RZD 18	2.65	-	3.35							3.57	**12.16**	1.9	**1.3**		
RZU 18	2.65	-	3.35							3.50	**12.03**	2.2	**1.3**		

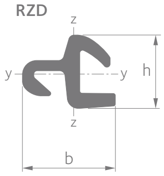
RH



RZU



RZD



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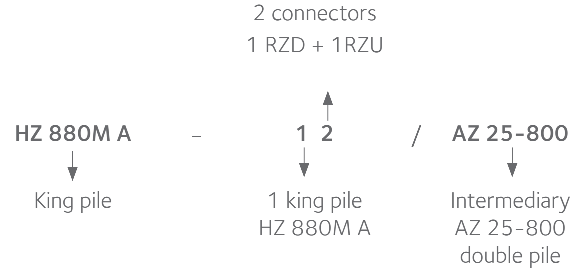
[1] Available upon request.

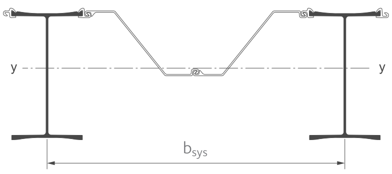
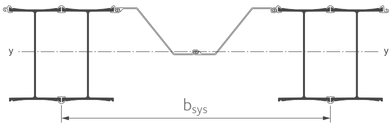
The outstanding feature of the HZ/AZ combined wall system is the extensive range of possible combinations using the entire AZ sheet pile offer, including the latest wide AZ-800 range, as well as all rolled-up and rolled-down AZ sections. The table below contains but a small sample of the available systems. **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:




Taipei Port, Taiwan


CT, JadeWeserPort, Germany

	Section	Sectional area in²/ft	Moment of inertia in⁴/ft	Elastic[1] section modulus in³/ft	Elastic[2] section modulus in³/ft	Mass[3] Mass100 lb/ft²	 Mass60 lb/ft²	Coating area[4] Water side ft²/ft
Combination HZ ... M - 12 / AZ 25-800	**HZ 630M[5]**	13.81	1 213.5	**90.6**	101.5	47.00	37.70	8.84
	HZ 880M A	13.30	1 761.4	**100.2**	114.4	45.26	36.12	8.97
	HZ 880M B	14.00	1 884.1	**107.7**	121.1	47.66	38.52	8.98
	HZ 880M C	14.32	1 967.5	**112.3**	125.9	48.75	39.62	8.98
	**HZ 1080M A**	14.93	3 064.1	**136.1**	152.6	50.80	41.64	8.96
	HZ 1080M B	15.44	3 288.0	**146.0**	162.8	52.54	43.39	8.96
	HZ 1080M C	16.36	3 557.7	**158.3**	174.8	55.67	46.52	8.97
	HZ 1080M D	17.11	3 821.0	**169.6**	186.8	58.21	49.07	8.97
b_{sys} = 83.74 in[6]	**HZ 1180M A**	17.70	4 018.8	**177.8**	195.7	60.24	51.10	8.97
	HZ 1180M B	18.08	4 192.4	**185.5**	203.4	61.54	52.40	8.98
	HZ 1180M C	18.82	4 447.2	**195.4**	215.3	64.05	54.78	9.02
	HZ 1180M D	19.41	4 647.7	**204.9**	223.4	66.05	56.78	9.04
Combination HZ ... M - 24 / AZ 25-800	**HZ 630M[5]**	17.84	1 728.7	**134.8**	124.0	60.70	52.99	10.43
	HZ 880M A	16.89	2 610.9	**155.5**	143.9	57.48	50.00	10.69
	HZ 880M B	18.03	2 804.6	**167.1**	155.3	61.35	53.88	10.71
	HZ 880M C	18.55	2 940.0	**174.7**	163.1	63.13	55.67	10.71
	**HZ 1080M A**	19.57	4 737.8	**218.7**	205.9	66.61	59.11	10.66
	HZ 1080M B	20.40	5 096.1	**234.6**	221.9	69.42	61.92	10.67
	HZ 1080M C	21.90	5 532.0	**254.3**	241.9	74.52	67.03	10.68
	HZ 1080M D	23.12	5 959.3	**272.7**	261.2	78.67	71.18	10.68
b_{sys} = 102.28 in[7]	**HZ 1180M A**	24.09	6 279.5	**285.9**	275.8	81.97	74.49	10.69
	HZ 1180M B	24.67	6 541.6	**297.1**	287.6	83.95	76.47	10.70
	HZ 1180M C	25.95	7 000.6	**316.4**	305.9	88.33	80.75	10.75
	HZ 1180M D	26.82	7 280.2	**328.3**	318.5	91.27	83.70	10.79

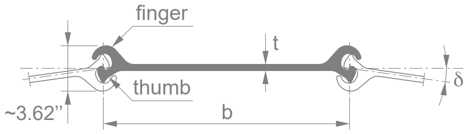
[1] Referring outside of HZ-M flange.
[2] Referring outside of RH / RZ.
[3] $L_{RH} = L_{HZ}$; $L_{RZU} = L_{RZD} = L_{AZ}$; $Mass_{100}$: L_{AZ} = 100 % L_{HZ}; $Mass_{60}$: L_{AZ} = 60 % L_{HZ}
[4] Excluding inside of interlocks, per system width.
[5] Available upon request.
[6] For HZ 630M b_{sys} = 82.28 in
[7] For HZ 630M b_{sys} = 99.37 in

AS 500® 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® Straight web steel sheet piles - design & execution manual" for further details.**

Section	Nominal width[1] b	Web thickness t	Deviation angle[2] δ	Perimeter	Sectional area	Mass	Mass per ft^2 of wall	Moment of inertia	Section modulus	Coating area[3]
				(single pile)				(single pile)		
	in	in	°	in	in^2	lb/ft	lb/ft^2	in^4	in^3	ft^2/ft
AS 500 - 9.5	19.69	0.375	4.5	54.33	12.6	42.87	**26.22**	4.04	2.81	1.90
AS 500 - 11.0	19.69	0.433	4.5	54.72	14.0	47.44	**28.88**	4.47	2.99	1.90
AS 500 - 12.0	19.69	0.472	4.5	54.72	14.7	49.93	**30.52**	4.71	3.11	1.90
AS 500 - 12.5	19.69	0.492	4.5	54.72	15.1	51.27	**31.34**	4.83	3.11	1.90
AS 500 - 12.7	19.69	0.500	4.5	54.72	15.2	51.81	**31.54**	4.90	3.11	1.90
AS 500 - 13.0[4]	19.69	0.512	4.5	55.12	15.6	53.09	**32.36**	5.12	3.30	1.90

[1] The effective width to be taken into account for design purposes (lay-out) is 19.80" for all AS 500 sheet piles.
[2] Max. deviation angle 4.0° for pile length > 66 ft.
[3] One side, excluding inside of interlocks.
[4] Please contact ArcelorMittal Sheet Piling for further information.




General cargo berth, Bal Haf, Yemen

The following characteristic interlock resistance can be guaranteed:

Section	F_{max} [kips/in][5]
AS 500 - 9.5	20.0
AS 500 - 11.0	22.8
AS 500 - 12.0	28.5
AS 500 - 12.5	31.4
AS 500 - 12.7	31.4
AS 500 - 13.0	34.2

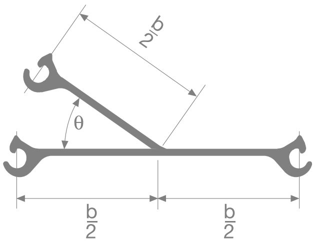
[5] For the related steel grade and further information, please contact ArcelorMittal Sheet Piling.

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

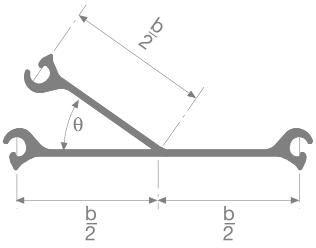

Bridge construction, South Korea

Junction piles and bent piles

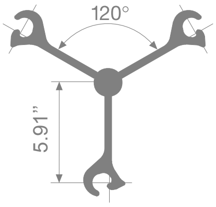
Junction piles that join circular cells and intermediary arcs can be provided. Bent piles are pre-bent at the mill. If the deviation angle exceeds 4.5° (4.0° if L > 66 ft), bent piles can be used to set up structures with small radii.



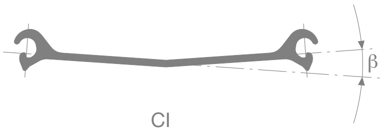
BI



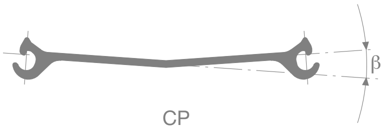
BP



Y

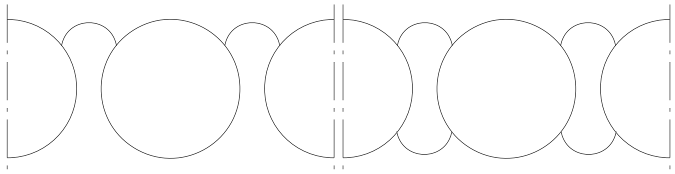


CI

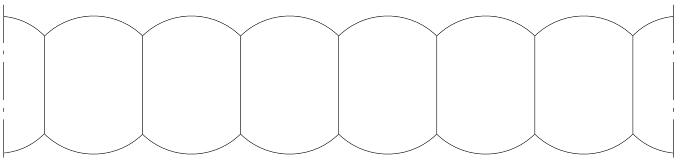


CP

Types of cells



Circular cells with 35° junction piles and one or two connecting arcs.



Diaphragm cells with 120° junction piles.

Hissmofors, Sweden

Lock, Arkansas, USA

Circular cell construction

1. Installation of template

2. Threading until cell closure

3. 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:

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

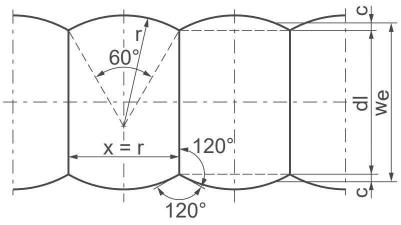
The ratio R_a indicates how economical the chosen circular cell will be.

It is defined as follows

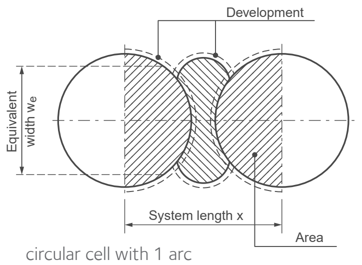
$$R_a = \frac{\textit{Development 1 cell + Development 1 (or 2) arc(s)}}{\textit{System length x}}$$

- **for diaphragm cells**

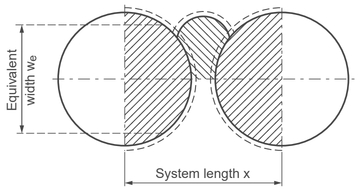
The equivalent width w_e is defined as:
w_e = diaphragm wall length (dl) + 2 · c



circular cell with 2 arcs

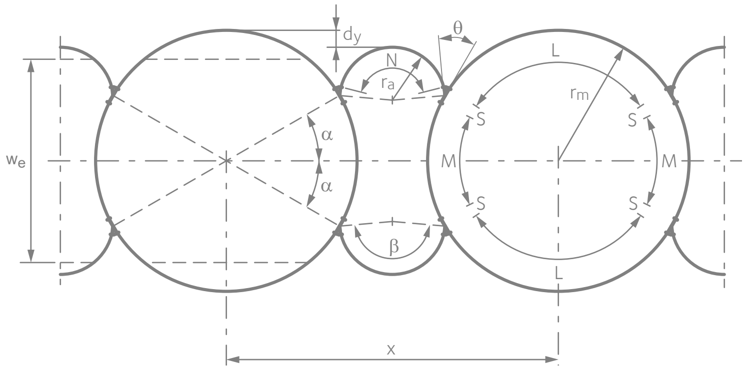


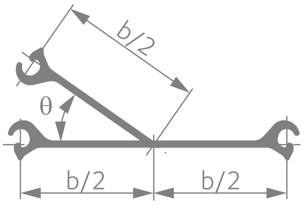
circular cell with 1 arc



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.





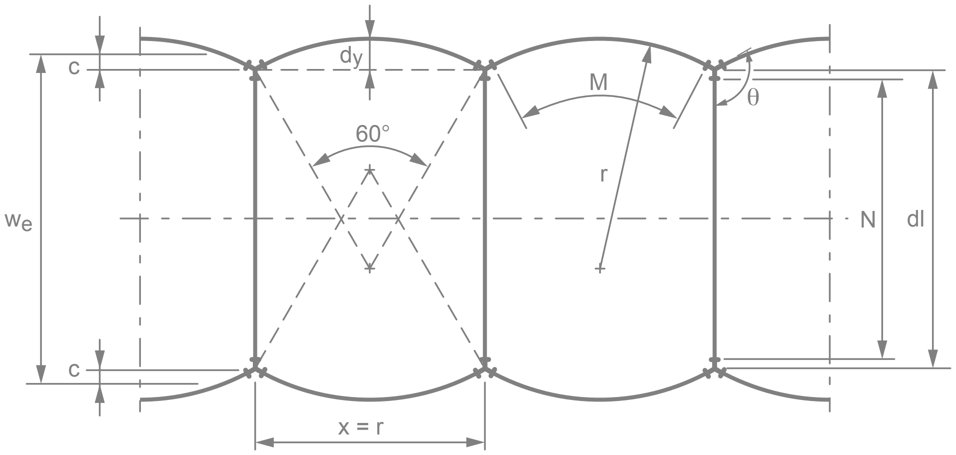
r_m = radius of the main cell
r_a = radius of the connecting arcs
θ = angle between the main cell and the connecting arc
x = system length
d_y = positive or negative offset between the connecting arcs and the tangent planes of the main cells
w_e = equivalent width

Junction piles with angles θ between 30° and 45°. as well as θ = 90°, are available on request.

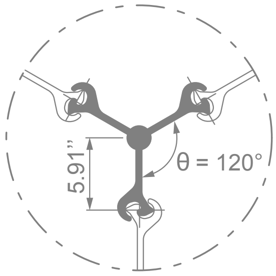
The table below shows a short selection of circular cells with 2 arcs and standard junction piles with θ = 35°.

Nb. of piles per						Geometrical values						Interlock deviation		Design values	
Cell				Arc	System							Cell	Arc	2 Arcs	
Total pcs.	L pcs.	M pcs.	S pcs.	N pcs.	pcs.	$d = 2 \cdot r_m$ ft	r_a ft	x ft	d_y ft	α °	β °	δ_m °	δ_a °	w_e ft	R_a
100	33	15	1	25	150	52.53	14.67	75.20	0.52	28.80	167.60	3.60	6.45	44.91	3.34
104	35	15	1	27	158	54.63	16.01	80.12	0.66	27.69	165.38	3.46	5.91	46.40	3.30
108	37	15	1	27	162	56.73	16.21	82.78	1.77	26.67	163.33	3.33	5.83	47.29	3.27
112	37	17	1	27	166	58.83	15.78	82.84	1.08	28.93	167.86	3.21	6.00	50.05	3.35
116	37	19	1	27	170	60.93	15.39	82.91	0.43	31.03	172.07	3.10	6.15	52.75	3.42
120	39	19	1	29	178	63.03	16.67	87.83	0.52	30.00	170.00	3.00	5.67	54.26	3.38
124	41	19	1	29	182	65.12	16.86	90.52	1.64	29.03	168.06	2.90	5.60	55.18	3.35
128	43	19	1	31	190	67.22	18.21	95.44	1.74	28.13	166.25	2.81	5.20	56.67	3.32
132	43	21	1	31	194	69.32	17.78	95.51	1.08	30.00	170.00	2.73	5.31	59.39	3.39
136	45	21	1	33	202	71.42	19.09	100.43	1.18	29.12	168.24	2.65	4.95	60.89	3.35
140	45	23	1	33	206	73.56	18.73	100.46	0.56	30.86	171.71	2.57	5.05	63.61	3.42
144	47	23	1	33	210	75.66	18.90	103.18	1.64	30.00	170.00	2.50	5.00	64.53	3.39
148	47	25	1	35	218	77.76	19.65	105.41	0.00	31.62	173.24	2.43	4.81	67.82	3.44
152	49	25	1	35	222	79.86	19.85	108.17	1.12	30.79	171.58	2.37	4.77	68.72	3.42

Geometry of diaphragm cells



Standard solution



r = radius
θ = 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

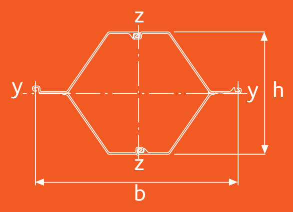
Tugboat berth, Panama Canal, Panama

Marina breakwater, Costa Rica

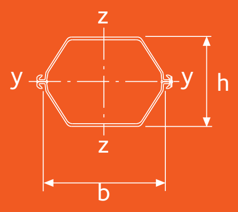
Geometry diaphragm wall	
Number of piles	Wall length
N pcs.	dl ft
11	19.13
13	22.44
15	25.75
17	29.04
19	32.35
21	35.63
23	38.94
25	42.26
27	45.54
29	48.85
31	52.13
33	55.45
35	58.76
37	62.04
39	65.35
41	68.64
43	71.95
45	75.26
47	78.54
49	81.86
51	85.14
53	88.45
55	91.77
57	95.05
59	98.36

Geometry arc (Standard solution)				
Number of piles	Radius System length	Arc height	Equivalent arc height	Interlock deviation
M pcs.	x = r ft	d_y ft	c ft	δ_a °
11	18.27	2.46	1.66	5.17
13	21.42	2.85	1.94	4.41
15	24.57	3.28	2.23	3.85
17	27.72	3.71	2.53	3.41
19	30.87	4.13	2.82	3.06
21	34.02	4.56	3.08	2.78
23	37.17	4.99	3.36	2.54
25	40.32	5.41	3.66	2.34
27	43.50	5.84	3.94	2.17
29	46.65	6.23	4.23	2.03
31	49.80	6.66	4.51	1.90
33	52.95	7.09	4.79	1.79
35	56.10	7.51	5.09	1.69
37	59.25	7.94	5.38	1.60
39	62.40	8.37	5.68	1.52
41	65.55	8.79	5.94	1.44
43	68.70	9.22	6.23	1.38

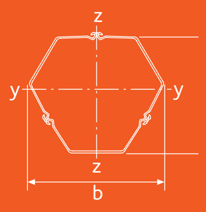
Box piles



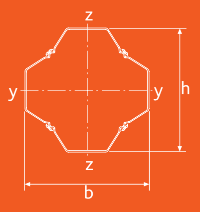
Z-box pile



Double U box pile



Triple U box pile



Quadruple U box pile

Section	Width	Height	Perimeter	Sectional area	Total section	Mass[1]	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area[2]
	b in	h in	in	in^2	in^2	lb/ft	y-y in^4	z-z in^4	y-y in^3	z-z in^3	in	ft^2/ft
CAZ-800 box piles												
CAZ 18-800	63.0	35.4	172.3	56.33	1 137.7	**191.70**	8 155.8	15 624.4	**459.8**	**483.0**	12.05	13.62
CAZ 20-800	63.0	35.4	172.5	61.95	1 142.7	**210.83**	8 947.6	17 139.7	**503.4**	**530.3**	12.00	13.64
CAZ 22-800	63.0	35.5	172.7	67.59	1 147.7	**230.01**	9 747.2	18 660.0	**547.1**	**577.6**	12.00	13.66
CAZ 23-800	63.0	37.3	175.4	65.57	1 203.4	**223.14**	10 748.1	18 173.7	**573.9**	**559.6**	12.80	13.88
CAZ 25-800	63.0	37.4	175.6	71.31	1 208.5	**242.67**	11 644.7	19 719.7	**620.6**	**609.6**	12.80	13.90
CAZ 27-800	63.0	37.5	175.8	77.05	1 213.5	**262.21**	12 546.3	21 269.6	**667.0**	**656.0**	12.80	13.91
CAZ-750 box piles												
CAZ 28-750	59.1	40.1	175.3	70.22	1 213.5	**238.98**	13 144.1	16 888.4	**653.9**	**554.1**	13.70	13.88
CAZ 30-750	59.1	40.2	175.5	75.97	1 218.4	**258.52**	14 179.1	18 232.1	**703.9**	**600.5**	13.66	13.89
CAZ 32-750	59.1	40.2	175.7	81.71	1 223.3	**278.08**	15 219.8	19 581.8	**754.3**	**642.9**	13.66	13.91
CAZ-700 and CAZ-770 box piles												
CAZ 12-770	60.6	27.1	153.2	50.81	841.7	**172.93**	4 205.8	13 405.7	**309.7**	**426.3**	9.09	12.03
CAZ 13-770	60.6	27.1	153.3	53.30	844.1	**181.40**	4 407.1	14 046.0	**324.0**	**446.7**	9.09	12.04
CAZ 14-770	60.6	27.2	153.4	55.79	846.4	**189.87**	4 609.0	14 686.5	**338.4**	**467.1**	9.09	12.05
CAZ 14-770 -10/10	60.6	27.2	153.5	58.28	848.7	**198.34**	4 811.7	15 327.0	**352.7**	**487.9**	9.09	12.06
CAZ 12-700	55.1	24.7	141.9	46.96	701.3	**159.80**	3 309.9	10 128.9	**266.4**	**353.0**	8.39	11.09
CAZ 13-700	55.1	24.8	142.1	51.50	705.5	**175.25**	3 625.1	11 080.6	**290.8**	**386.6**	8.39	11.11
CAZ 13-700-10/10	55.1	24.8	142.2	53.78	707.6	**183.01**	3 784.7	11 558.2	**303.0**	**403.4**	8.39	11.12
CAZ 14-700	55.1	24.9	142.3	56.04	709.7	**190.71**	3 943.2	12 032.2	**315.2**	**420.2**	8.39	11.13
CAZ 17-700	55.1	33.0	154.0	51.20	932.3	**174.25**	6 373.4	11 002.2	**384.5**	**383.5**	11.14	12.10
CAZ 18-700	55.1	33.1	154.1	53.71	934.5	**182.79**	6 675.1	11 527.0	**402.1**	**402.1**	11.14	12.11
CAZ 20-700	55.1	33.1	154.3	58.73	939.0	**199.88**	7 281.7	12 576.1	**437.5**	**439.1**	11.14	12.13
CAZ 24-700	55.1	36.1	160.2	67.54	1 025.4	**229.86**	9 921.4	14 340.5	**547.1**	**504.1**	12.13	12.61
CAZ 26-700	55.1	36.2	160.4	72.75	1 030.0	**247.60**	10 674.3	15 420.4	**587.4**	**543.1**	12.13	12.63
CAZ 28-700	55.1	36.3	160.6	77.97	1 034.5	**265.34**	11 431.3	16 502.3	**627.6**	**580.3**	12.13	12.65

[1] The mass of the welds is not taken into account.
[2] Outside surface, excluding inside of interlocks.

Section	Width	Height	Perimeter	Sectional area	Total section	Mass[1]	Moment of inertia		Elastic section modulus		Min. radius of gyration	Coating area[2]
	b	h					y-y	z-z	y-y	z-z		
	in	in	in	in^2	in^2	lb/ft	in^4	in^4	in^3	in^3	in	ft^2/ft
CAZ-700 and CAZ-770 box piles												
CAZ 36-700N	55.1	39.3	170.9	82.77	1 118.4	**281.67**	15 063.7	17 076.2	**764.3**	**603.8**	13.50	13.51
CAZ 38-700N	55.1	39.4	171.2	88.35	1 123.0	**300.67**	16 046.3	18 199.7	**812.5**	**643.8**	13.46	13.53
CAZ 40-700N	55.1	39.4	171.5	93.93	1 127.7	**319.66**	17 034.0	19 323.3	**860.7**	**683.8**	13.46	13.56
CAZ 42-700N	55.1	39.3	170.6	100.11	1 126.5	**340.68**	17 885.2	20 562.0	**907.4**	**727.1**	13.39	13.48
CAZ 44-700N	55.1	39.4	170.8	105.70	1 131.1	**359.72**	18 874.5	21 689.8	**955.6**	**767.1**	13.35	13.50
CAZ 46-700N	55.1	39.4	170.8	111.30	1 135.8	**378.77**	19 869.4	22 818.0	**1.004.1**	**807.0**	13.35	13.50
CAZ 48-700	55.1	39.6	171.1	110.12	1 138.7	**374.76**	20 313.9	22 375.2	**1.021.8**	**791.2**	13.58	13.52
CAZ 50-700	55.1	39.7	171.3	115.68	1 143.3	**393.67**	21 320.3	23 485.6	**1.070.4**	**831.1**	13.58	13.54
CAZ 52-700	55.1	39.8	171.5	121.23	1 148.0	**412.58**	22 332.4	24 596.8	**1.118.9**	**869.9**	13.58	13.56
CAZ box piles												
CAZ 18	49.6	29.9	142.1	51.62	763.4	**175.38**	5 355.9	8 781.1	**356.4**	**339.3**	10.20	11.11
CAZ 26	49.6	33.6	148.4	68.52	862.7	**232.50**	8 813.1	11 631.9	**522.1**	**450.7**	11.38	11.64

[1] The mass of the welds is not taken into account.
[2] Outside surface, excluding inside of interlocks.

Wroclaw flood protection system, Poland

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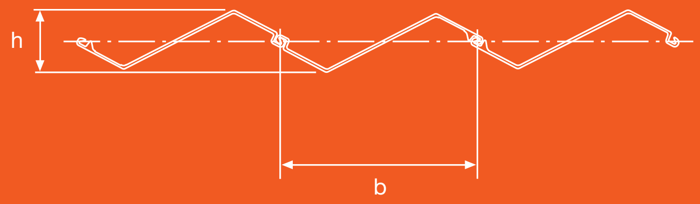
Jagged wall



AZ® jagged wall: AZ® 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® jagged wall

Section	Width b in	Height h in	Sectional area in²/ft	Mass lb/ft²	Moment of inertia in⁴/ft	Elastic section modulus in³/ft	Coating area[1] ft²/ft²
AZ-800							
AZ 18-800	35.32	9.53	5.42	**18.43**	35.0	**7.3**	1.16
AZ 20-800	35.32	9.58	5.94	**20.22**	39.1	**8.2**	1.16
AZ 22-800	35.32	9.62	6.47	**22.00**	43.2	**9.0**	1.16
AZ 23-800	35.72	10.06	6.27	**21.35**	44.5	**8.8**	1.17
AZ 25-800	35.72	10.10	6.80	**23.15**	48.8	**9.7**	1.17
AZ 27-800	35.72	10.15	7.33	**24.95**	53.2	**10.5**	1.17
AZ-750							
AZ 28-750	34.70	10.96	6.88	**23.42**	58.4	**10.7**	1.20
AZ 30-750	34.70	11.00	7.43	**25.27**	63.7	**11.6**	1.20
AZ 32-750	34.70	11.05	7.97	**27.13**	69.0	**12.5**	1.20
AZ-700 and AZ-770							
AZ 12-770	32.53	7.14	5.29	**18.00**	17.0	**4.8**	1.12
AZ 13-770	32.53	7.16	5.54	**18.85**	18.0	**5.0**	1.12
AZ 14-770	32.53	7.18	5.79	**19.71**	18.9	**5.3**	1.12
AZ 14-770-10/10	32.53	7.21	6.04	**20.55**	19.9	**5.5**	1.12
AZ 12-700	29.55	7.16	5.43	**18.47**	17.6	**4.9**	1.13
AZ 13-700	29.55	7.20	5.93	**20.19**	19.6	**5.5**	1.13
AZ 13-700-10/10	29.55	7.22	6.19	**21.06**	20.6	**5.7**	1.13
AZ 14-700	29.55	7.24	6.44	**21.91**	21.6	**6.0**	1.13
AZ 17-700	31.28	8.80	5.54	**18.85**	27.1	**6.1**	1.16
AZ 18-700	31.28	8.83	5.79	**19.72**	28.6	**6.5**	1.16
AZ 19-700	31.28	8.85	6.06	**20.63**	30.2	**6.8**	1.16
AZ 20-700	31.28	8.87	6.32	**21.52**	31.7	**7.2**	1.16
AZ 24-700	32.00	9.49	7.09	**24.12**	43.7	**9.2**	1.19
AZ 26-700	32.00	9.53	7.62	**25.92**	47.6	**10.0**	1.19
AZ 28-700	32.00	9.58	8.15	**27.73**	51.4	**10.7**	1.19

---

[1] One side, excluding inside of interlocks.

AZ® jagged wall

Section	Width b in	Height h in	Sectional area in²/ft	Mass lb/ft²	Moment of inertia in⁴/ft	Elastic section modulus in³/ft	Coating area[1)] ft²/ft²
AZ-700 and AZ-770							
AZ 36-700N	32.83	11.67	8.56	**29.14**	87.1	**14.9**	1.23
AZ 38-700N	32.83	11.72	9.12	**31.05**	93.1	**15.9**	1.23
AZ 40-700N	32.83	11.77	9.68	**32.96**	99.1	**16.8**	1.24
AZ 42-700N	32.83	11.81	10.26	**34.92**	107.9	**18.3**	1.24
AZ 44-700N	32.83	11.86	10.82	**36.83**	113.9	**19.2**	1.24
AZ 46-700N	32.83	11.91	11.38	**38.74**	119.9	**20.1**	1.24
AZ 48-700	32.91	11.91	11.41	**38.83**	119.3	**20.0**	1.23
AZ 50-700	32.91	11.94	11.97	**40.74**	125.2	**21.0**	1.23
AZ 52-700	32.91	12.01	12.53	**42.65**	131.1	**21.8**	1.23
AZ							
AZ 18	28.11	8.84	6.27	**21.35**	31.3	**7.1**	1.19
AZ 18-10/10	28.11	8.86	6.56	**22.31**	33.0	**7.4**	1.19
AZ 26	28.97	9.36	8.00	**27.23**	48.2	**10.3**	1.21

[1)] One side, excluding inside of interlocks.

Temporary trench, Brenner railway, Austria

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®-M king piles / sheet piles;
- tubular king piles / sheet piles.

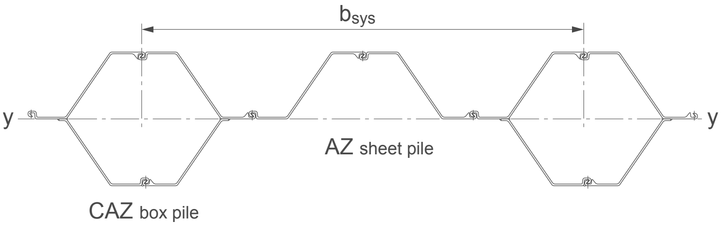
The primary piles or “king piles” of combined walls can also be used as bearing piles submitted to high vertical loads. e.g. crane loads. The intermediary sheet piles act mainly as soil-retaining and load-transferring elements.

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}	[in^4/ft] :	Moment of inertia of combined wall
W_{sys}	[in^3/ft] :	Elastic section modulus of combined wall
$I_{king\ pile}$	[in^4] :	Moment of inertia of king pile
I_{ssp}	[in^4] :	Moment of inertia of intermediary sheet pile
$W_{king\ pile}$	[in^3] :	Elastic section modulus of king pile
b_{sys}	[ft] :	System width

CAZ box piles – AZ® sheet piles

Combination	System width b_{sys} in	$Mass_{100}$ 1) lb/ft²	$Mass_{60}$ 1) lb/ft²	Moment of inertia I_{sys} in⁴/ft	Elastic section modulus W_{sys} in³/ft
AZ-800					
CAZ 20-800 / AZ 13-770	123.62	30.31	26.42	948.9	53.4
CAZ 20-800 / AZ 18-700	118.11	31.95	27.65	1 038.3	58.4
CAZ 20-800 / AZ 20-800	125.98	31.34	26.83	1 017.2	57.2
CAZ 25-800 / AZ 13-770	123.62	33.38	29.49	1 210.7	64.5
CAZ 25-800 / AZ 18-700	118.11	35.02	30.93	1 312.3	69.9
CAZ 25-800 / AZ 20-800	125.98	34.41	29.90	1 274.1	67.9
AZ-750					
CAZ 30-750 / AZ 13-770	119.69	36.25	32.16	1 504.7	74.7
CAZ 30-750 / AZ 18-700	114.26	37.89	33.59	1 623.9	80.6
CAZ 30-750 / AZ 20-800	122.14	37.07	32.36	1 564.4	77.7
AZ-700 and AZ-770					
CAZ 13-770 / AZ 13-770	121.26	28.06	23.96	518.0	38.0
CAZ 13-700 / AZ 13-700	110.24	29.90	25.60	469.8	37.7
CAZ 18-700 / AZ 13-770	115.75	29.49	25.40	777.8	46.9
CAZ 18-700 / AZ 13-700	110.24	30.72	26.42	801.9	48.3
CAZ 18-700 / AZ 18-700	110.24	31.13	26.63	865.1	52.1

1) $Mass_{100}$: L_{AZ} = 100% $L_{box\ pile}$; $Mass_{60}$: L_{AZ} = 60% $L_{box\ pile}$.

CAZ box piles – AZ® sheet piles

Combination	System width b_{sys} in	$Mass_{100}$ [1] lb/ft²	$Mass_{60}$ [1] lb/ft²	Moment of inertia I_{sys} in⁴/ft	Elastic section modulus W_{sys} in³/ft
AZ-700 and AZ-770					
CAZ 26-700 / AZ 13-770	115.75	**36.25**	**31.95**	1 192.5	**65.7**
CAZ 26-700 / AZ 13-700	110.24	**37.89**	**33.38**	1 237.2	**68.1**
CAZ 26-700 / AZ 18-700	110.24	**38.10**	**33.59**	1 300.4	**71.5**
CAZ 38-700N / AZ 13-770	115.75	**41.78**	**37.48**	1 749.4	**88.5**
CAZ 38-700N / AZ 13-700	110.24	**43.63**	**39.32**	1 822.0	**92.3**
CAZ 38-700N / AZ 18-700	110.24	**43.83**	**39.53**	1 885.2	**95.4**
CAZ 44-700N / AZ 13-770	115.75	**47.93**	**43.63**	2 042.6	**103.4**
CAZ 44-700N / AZ 13-700	110.24	**49.97**	**45.67**	2 129.9	**107.9**
CAZ 44-700N / AZ 18-700	110.24	**50.38**	**45.88**	2 193.1	**111.0**
CAZ 50-700 / AZ 13-770	115.75	**51.41**	**47.11**	2 296.2	**115.3**
CAZ 50-700 / AZ 18-700	110.24	**54.05**	**49.57**	2 459.4	**123.5**
CAZ 50-700 / AZ 20-800	118.11	**52.08**	**47.25**	2 342.1	**117.6**
AZ					
CAZ 18 / AZ 18	99.21	**33.38**	**28.47**	773.0	**51.4**
CAZ 26 / AZ 18	99.21	**40.14**	**35.43**	1 191.2	**70.6**

[1] $Mass_{100}$: L_{AZ} = 100% $L_{box\ pile}$; $Mass_{60}$: L_{AZ} = 60% $L_{box\ pile}$.

Underground car park, Aalst, Belgium

Delivery conditions

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

Tolerances	AZ®	AS 500®	HZ®-M
Mass1)	± 5%	± 5%	± 5%
Length (L)	± 7.9 in	± 7.9 in	± 7.9 in
Height (h)2)	h ≥ 11.8 in: ± 0.28 in	-	h ≥ 19.7 in: ± 0.28 in
Thicknesses (t,s)	t, s ≤ 0.335 in: ± 0.02 in t, s > 0.335 in: ± 6 %	t > 0.335 in: ± 6 %	t, s > 0.492 in: –0.06 in / + 0.10 in
Width single pile (b)	± 2% b	± 2% b	± 2% b
Width double pile (2b)	± 3% (2b)	± 3% (2b)	± 3% (2b)
Straightness (q)	≤ 0.2% L	≤ 0.2% L	≤ 0.2% L
Ends out of square	± 2% b	± 2% b	± 2% b

1) From the mass of the total delivery.

2) Of single pile.

Maximum rolling lengths (longer sections available on request)

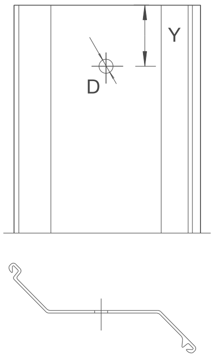
Section	AZ	AS 500	HZ-M	RH / RZ	OMEGA 18	C9 / C14	DELTA 13
Length [ft]	101.7	101.7	108.3	78.7	52.5	59.1	55.8

Handling holes

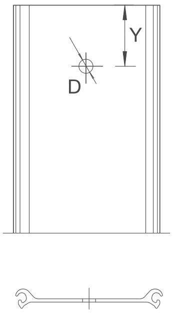
Sheet pile sections are normally supplied without handling holes. If requested, they can be provided with handling holes in the centreline of the section. The standard handling hole dimensions are as follows:

Diameter D [in]	1.6	1.6	1.6	2.0	2.0	2.5
Distance Y [in]	3.0	5.9	11.8	7.9	9.8	9.0

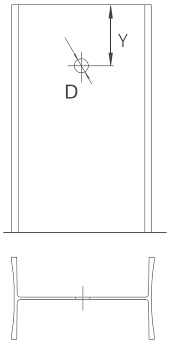
Z-Section



Straight Web Section

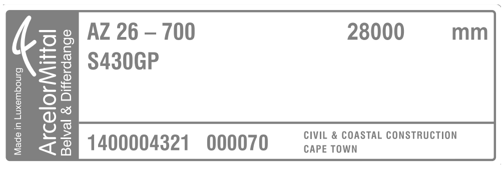


HZ-M-Section



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.



Made in Luxembourg
ArcelorMittal
Belval & Differdange

AZ 26 – 700 28000 mm
S430GP

1400004321 000070
CIVIL & COASTAL CONSTRUCTION
CAPE TOWN

Steel grades of sheet pile sections

Steel grade EN 10248	Min. yield strength R_{eH} ksi	Min. tensile strength R_m ksi	Min. elongation $L_o=5.65\sqrt{S_o}$ %	Chemical composition[1] (% max)					
				C	Mn	Si	P	S	N[2,3]
S 240 GP	**34.8**	49.3	26	0.25	–	–	0.055	0.055	0.011
S 270 GP	**39.2**	59.5	24	0.27	–	–	0.055	0.055	0.011
S 320 GP	**46.4**	63.8	23	0.27	1.70	0.60	0.055	0.055	0.011
S 355 GP	**51.5**	69.6	22	0.27	1.70	0.60	0.055	0.055	0.011
S 390 GP	**56.6**	71.1	20	0.27	1.70	0.60	0.050	0.050	0.011
S 430 GP	**62.4**	74.0	19	0.27	1.70	0.60	0.050	0.050	0.011
ArcelorMittal mill specification									
S 460 AP	**66.7**	79.8	17	0.27	1.70	0.60	0.050	0.050	0.011

AMLoCor®	Min. yield strength R_{eH} ksi	Min. tensile strength R_m ksi	Min. elongation $L_o=5.65\sqrt{S_o}$ %	Chemical composition[1] (% weight)							
				(% max.)						(% min.)	
				C	Mn	Si	P	S	N[2,3]	Cr	Al
Blue 320	**46.4**	63.8	23	0.27	1.70	0.60	0.05	0.05	0.011	0.75	0.40
Blue 355	**51.5**	69.6	22	0.27	1.70	0.60	0.05	0.05	0.011	0.75	0.40
Blue 390	**56.6**	71.1	20	0.27	1.70	0.60	0.05	0.05	0.011	0.75	0.40

All the sections can be delivered in steel grades according to EN 10248-1, but not all sections are available in all steel grades. Below table summarizes the current possibilities. Special steel grades like **S 460 AP**, 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 Chapter 10.4 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	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 AP
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	–	–

Steel Grade / Section	EN 10248							ASTM	
	S 240 GP	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 AP	A 572	A 690
AZ-700 to 800	✓[4]	✓	✓	✓	✓	✓	✓	✓	✓
AZ	✓[4]	✓	✓	✓	✓	✓	✓	✓	✓[4]
HZ-M	✓[4]	✓	✓	✓	✓	✓	✓	✓	✓
RH / RZD / RZU	×	×	×	×	×	✓	✓	×	✓
C 9	×	×	×	✓	×	×	×	✓	×
C 14	×	×	×	✓	×	×	×	×	×
Delta 13	×	×	×	✓	×	×	×	×	×
Omega 18	×	×	×	×	×	✓	✓	×	×

	AMLoCor®		
	Blue 320	Blue 355	Blue 390
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	×	✓	×

✓ Available.
× Currently unavailable.

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[1] Product analysis. Maximum copper content of 0.6% for non-alloyed steel.

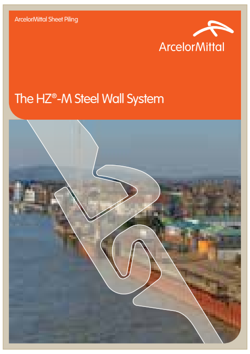
[2] It is permissible to exceed the specific values provided that for each increase of 0.001% N, the P max content will be reduced by 0.005%. However, the N content shall not exceed 0.012% on the ladle analysis and 0.014% on the product analysis.

[3] The maximum value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0.020% or if sufficient other N binding elements are present.

[4] Please contact us as some limitations may apply.

Documentation

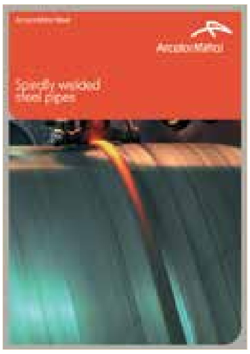
Please refer to our website to download all our documentation: **sheetpiling.arcelormittal.com**
or contact us via E-mail: **sheetpiling@arcelormittal.com**


ArcelorMittal Sheet Piling
ArcelorMittal
The HZ®-M Steel Wall System

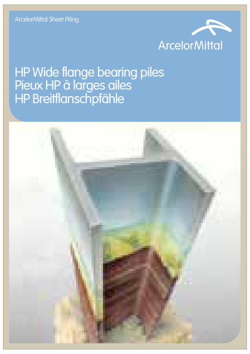
The HZ®-M Steel Wall System
GB, ES, PT


ArcelorMittal
Design & Execution Manual
AS 500 Straight Web Steel Sheet Piles

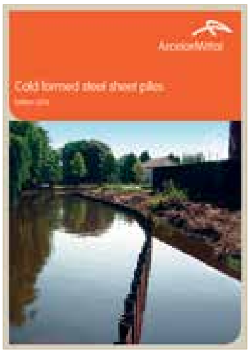
AS 500® Straight web steel sheet piles
Design and Execution
GB


ArcelorMittal
Spirally welded steel pipes

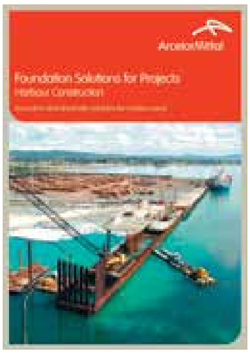
Spirally welded steel pipes
GB


ArcelorMittal Sheet Piling
ArcelorMittal
HP Wide flange bearing piles
Pieux HP à larges ailes
HP Breitflanschpfähle

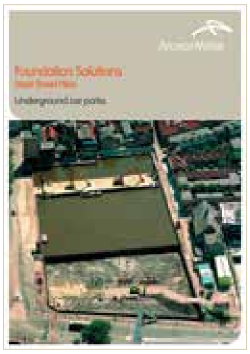
HP bearing piles
GB, DE, FR, SP


ArcelorMittal
Cold formed steel sheet piles

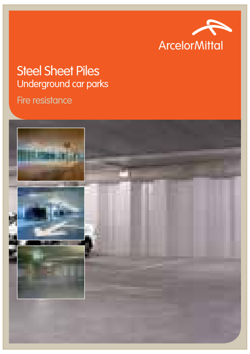
Cold formed steel piles
GB, DE, FR, NL


ArcelorMittal
Foundation Solutions for Projects
Harbour Construction

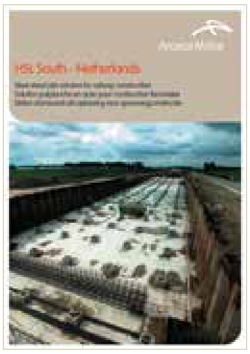
Harbour construction
GB, RU


ArcelorMittal
Foundation Solutions
Steel Sheet Piles
Underground car parks

Underground car parks
GB, PT


ArcelorMittal
Steel Sheet Piles
Underground car parks
Fire resistance

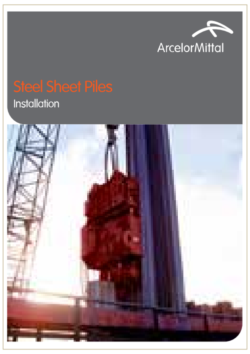
Underground car parks
Fire resistance
GB


ArcelorMittal
HSL South - Netherlands

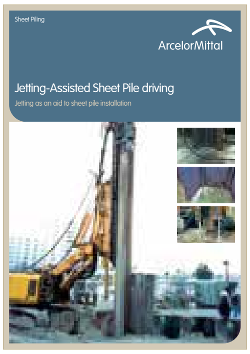
High speed line south – NL
GB, FR, NL


ENVIRONMENTAL PRODUCT DECLARATION
Hot-rolled steel sheet piling
ArcelorMittal
EPD

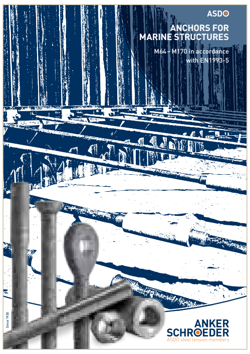
Environmental
Product Declaration
GB


ArcelorMittal
Steel Sheet Piles
Installation

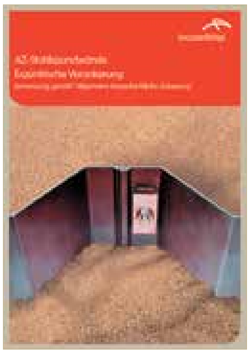
Installation of sheet piles
GB, FR


Sheet Piling
ArcelorMittal
Jetting-Assisted Sheet Pile driving
Jetting as an aid to sheet pile installation

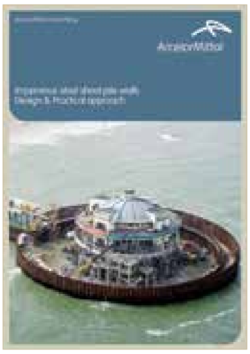
Jetting-assisted sheet pile driving
GB, DE, FR


ASDO
ANCHORS FOR
MARINE STRUCTURES
M64 - M170 in accordance
with EN1993-5
ANKER
SCHROEDER

Anchoring of sheet piles
GB, DE


ArcelorMittal

Off-centre anchoring
GB, DE, FR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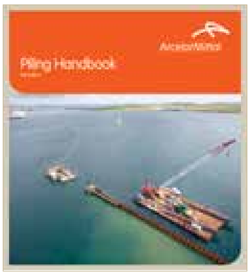
Impervious steel sheet pile walls
Design & Practical approach

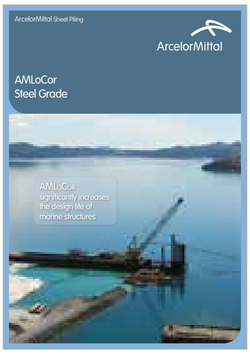
Impervious steel sheet pile walls
GB, DE, FR


ArcelorMittal
Piling Handbook

Piling Handbook
GB


ArcelorMittal Sheet Piling
ArcelorMittal
Dixeran®
Declutching detector | Détecteur de dégrafage | Schlosssprungdetektor

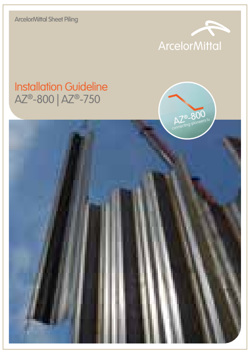
Declutching detector
GB, DE, FR


ArcelorMittal Sheet Piling
ArcelorMittal
AMLoCor
Steel Grade
AMLoCor
significantly increases
the design life of
marine structures

AMLoCor Steel Grade
GB, DE, FR


ArcelorMittal Sheet Piling
ArcelorMittal
AZ sheet piles in combined walls
Les palplanches AZ dans les rideaux mixtes
AZ-Zwischenbohlen in kombinierten Wänden

AZ sheet piles in combined walls
GB, DE, FR


ArcelorMittal Sheet Piling
ArcelorMittal
Installation Guideline
AZ®-800 | AZ®-750
AZ®-800

Installation Guideline
AZ®-800 | AZ®-750
GB, DE, FR

Trademarks

ArcelorMittal is the owner of following trademark applications or registered trademarks:
“AS 500”, “AU”, “AZ”, “GU”, “HZ”, “HZ-M”, “HZ/AZ” , “PU”, “AMLoCor”, “AKILA”, “Beltan”, “ROXAN”, “Arcoseal” , “HISTAR”, “XCarb”, “EcoSheetPile Plus”.

In communications and documents the symbol ™ or ® must follow the trademark on its first or most prominent instance, for example:
AZ®, AU™

Credit lines must be used on all communications and documents where a trademark is used, for example:
AZ is a trademark of ArcelorMittal group
AU, AZ and HZ are trademarks of ArcelorMittal group
AZ 26-700 is a steel sheet pile manufactured by ArcelorMittal group

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