NIPPON STEEL

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STEEL SHEET PILES
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NIPPON STEEL

STEEL SHEET PILES

NET ZERO
NIPPON STEEL
Green Transformation
initiative

NIPPON STEEL CORPORATION

Applications and structural types of sheet piles

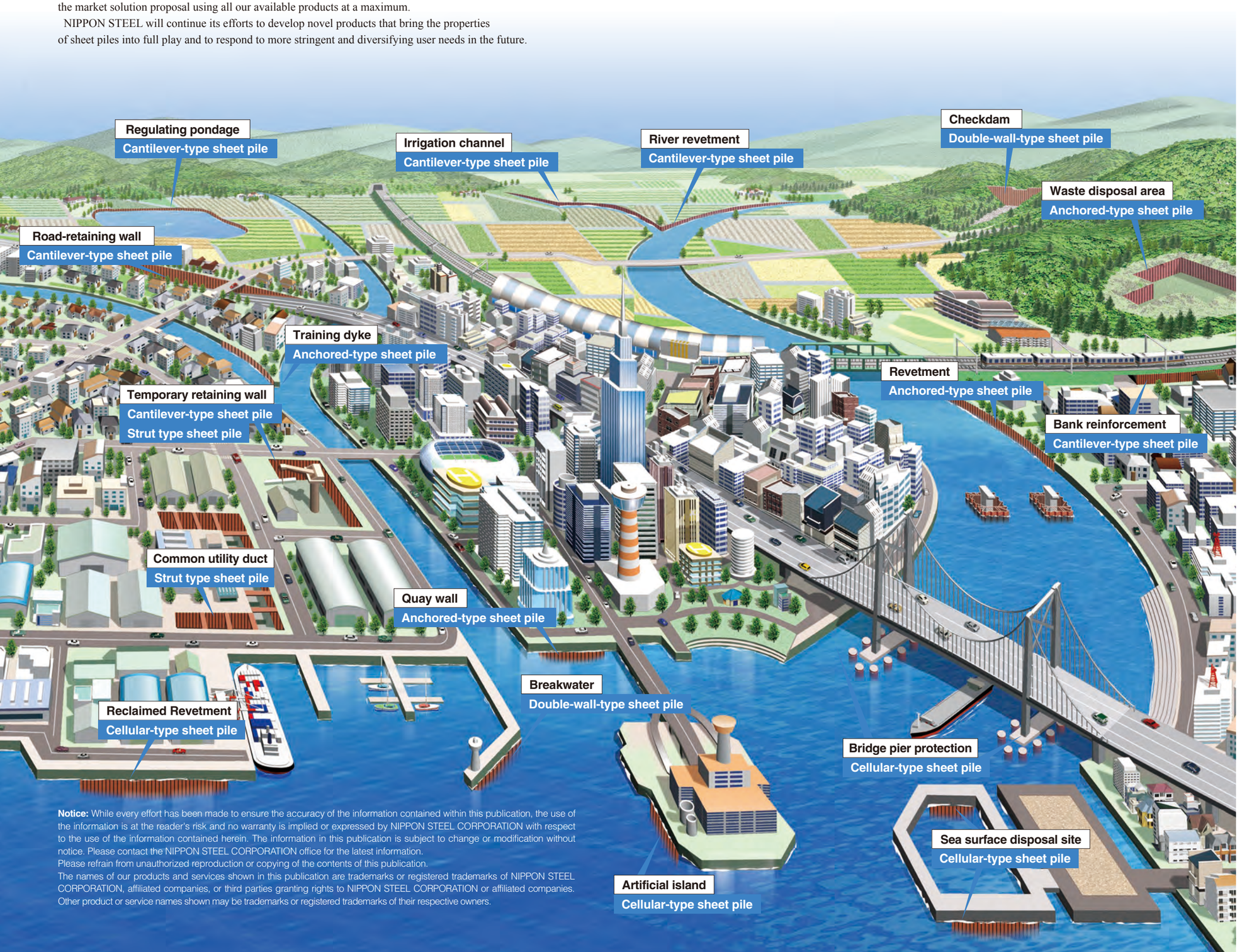
Leading the New Era on Steel Sheet Pile with Pioneer Spirits

The steel sheet piles of NIPPON STEEL are used in many fields (port and harbor structures, river revetments, retaining walls and cofferdams) and have acquired high market acceptance due to their excellent product quality and construction efficiencies that derive from their use.

NIPPON STEEL, drawing a wealth of rolling, fabrication and construction methods in these fields, which have also won for the company a high reputation.

Based on an accumulation of technical expertise, NIPPON STEEL has developed and placed on the market solution proposal using all our available products at a maximum.

NIPPON STEEL will continue its efforts to develop novel products that bring the properties of sheet piles into full play and to respond to more stringent and diversifying user needs in the future.



Advantages of steel sheet piles over other methods (masonry, RC walls, etc.)

(1) Quick construction: Dramatic reduction in the construction period
(2) Reliability for long-term use: Increases the safety factor and reduces the deformation of the wall using robust steel sheet piles
(3) Availability of long pile and deep embedment: Up to 38m in length
(4) Sustainability: Remove and reuse possible
(5) Availability of narrow areas

Features

Wide Selection of Shapes and Types

Sheet pile is available in a wide range of section modulus per meter of pile wall, ranging from 902 to 19,280 cm³/m. This allows selection of the most economical type of sheet pile to meet the design requirements and the intended construction method.

Superb Drivability and Watertightness

The clearance between the two threaded interlocks is moderate enough to ensure both excellent drivability and reliable watertightness.

Contents

Applications

Quay wall, revetment, artificial island

Hat+H　Guam Apra Port refurbishment / USA

Hat-type Sheet pile River revetment / Thailand

Steel Sheet Pile Cell (Straight web-type sheet pile)　Hong Kong Macau Artificial Island / Hong Kong

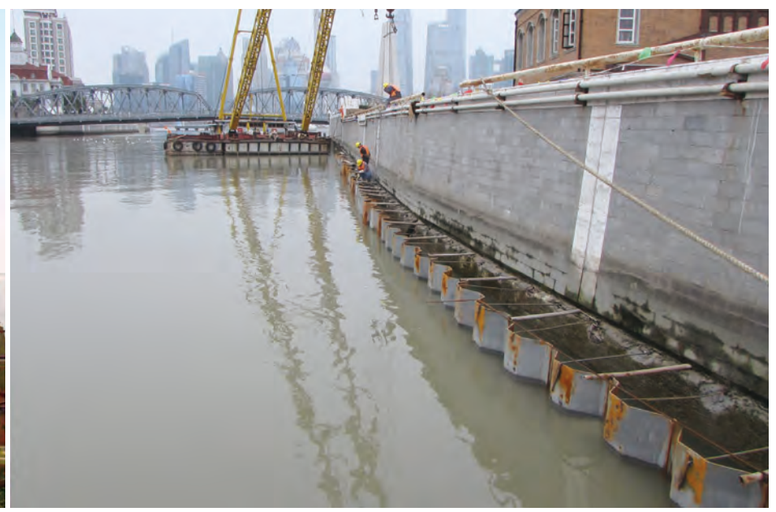
Hat-type Sheet pile　Quay wall as port reinforcement in Benoa Port / Indonesia

Hat-type Sheet Pile　O-Bahn City Access Project / Australia

Hat-type Sheet Pile　Church point seawall / Australia

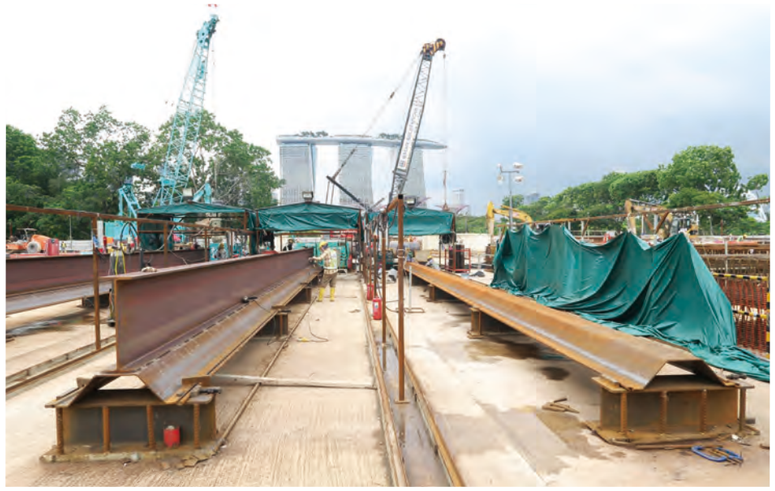
Permanent retaining wall

Hat+H　Pasig-Marikina River Channel Improvement Project(Phase 3) / Philippine



Hat-type Sheet Pile / China

Temporary retaining wall



Hat-type Sheet Pile / Singapore

Hat-type Sheet Pile / New Zealand

Hat+H / China

NS-SP-J Pile / Singapore

Hat-type Sheet Pile / Singapore

Example of solution

NIPPON STEEL provides comprehensive solutions.

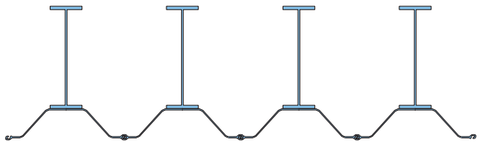
We have a team of civil engineers at the head office and the overseas offices. And we can propose the optimum design plan by our products through discussions with our customer in a given time after we obtain the design conditions. This is our complimentary engineering support to our customer. (Our proposal is for reference of our customer. The responsible judgment is up to the customer.) (Refer to pages 15 and 16.)

Various types and sizes of sheet piles are available. The optimum type and size is selected based on the design conditions and the construction method. (902cm³/m to 19,280cm³/m) (Refer to pages 9 and 10.)

Do you have a steel sheet pile that can be easily installed?

High stiffness wall

Hat-type and H-shape combined high stiffness steel sheet pile



● Each pile of wall has uniform shape and rigidity. Therefore only one type of piling machine is required for installation and the sequential installation in the same direction is possible. This leads to easy installation. Welding can be carried out near the site. (Refer to pages 19 to 22)

We want to minimize deflection for safety when the front of a steel sheet pile is excavated. Can you provide a good steel sheet pile?

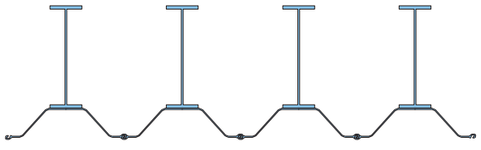
For Small-scale excavation

Hat-type sheet pile

● The interlocks are situated on the outmost side of the section. This makes it unnecessary to consider the reduction of sectional properties which are factored in with U-type sheet piles. This leads to reduction of the number of struts.
● The sheet piles can be re-used multiple times. (Refer to pages 17.)

For Large-scale excavation

Hat-type and H-shape combined high stiffness steel sheet pile



● The moment of inertia is almost twice as large as that of Z-type sheet pile. This leads to reduction of deflection and the number of struts.
● The sheet piles can be re-used multiple times. (Refer to pages 19 to 22.)

We want to use our land to the utmost. Can you provide a good steel sheet pile?

NS-SP-J pile and the dedicated press-in piler can construct a earth-retaining wall without dead space. This enables the full use of the premises to the boundary limits. (Refer to pages to 23.)

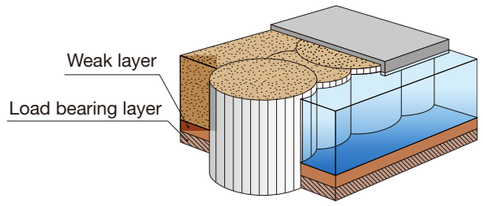
Can you provide a good method to build a large-scale revetment for reclamation?

The steel sheet pile is a good method to construct a revetment quickly. The special function required to construct the revetment for reclamation is the stability against waves until the completion of reclamation. The structure must be safe even without back reclamation.

Applicable to approx. 10-15m depth

Steel sheet pile cell

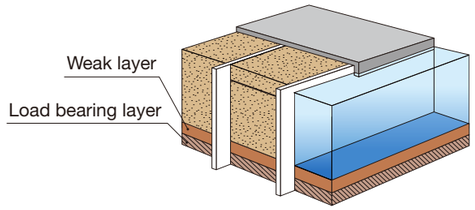
● This is a gravitational wall featuring a cylindrical shape assembled with straight web-type sheet piles. Inside is filled with sand. It is excellent in structural stability.
● A prefabricated sheet pile cell method can provide quick construction. (Refer to pages 29 to 31.)



Applicable to less than 10m depth

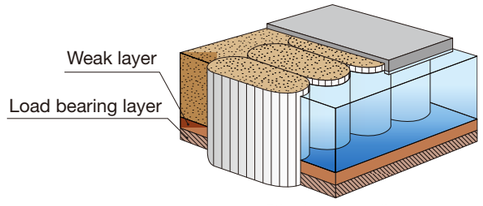
Steel sheet pile double wall

● This is a gravitational wall in which steel sheet piles are installed in two rows. The tops of the sheet piles are connected by tie rods. And the space between the sheet piles is filled with sand. It is excellent in structural stability.
● By dividing the construction site into multiple zones and by pairing a group of ships, the construction lead time can be reduced.

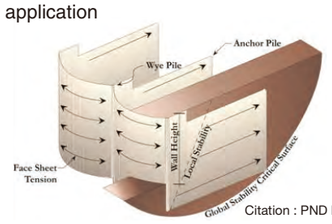


Applicable to over 15m depth

Straight web-type sheet pile application



Diaphragm cell



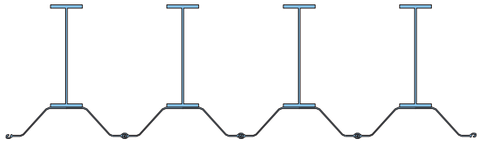
Citation : PND ENGINEERS, INC.

Open cell

Do you have any steel sheet pile method that is environmentally friendly?

E.g. Temporary earth-retaining wall

Hat-type and H-shape combined high stiffness steel sheet pile



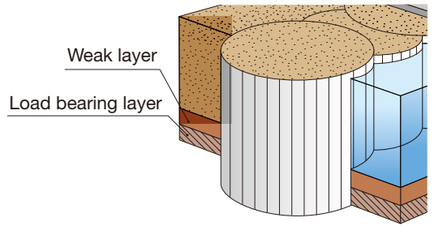
Hat-type sheet pile

● Unlike a concrete-based temporary earth-retaining wall, the steel sheet pile wall can be repeatedly used and is environmentally friendly. In construction, sludge is not generated, and the disposal of soil is not required. (Refer to pages 17 to 22.)

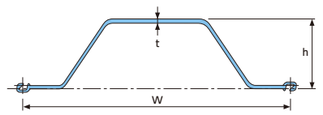
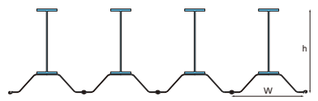
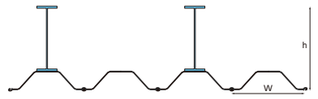
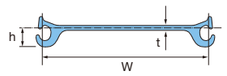
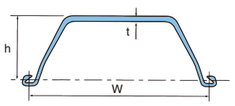
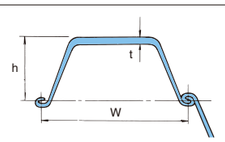
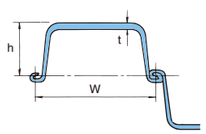
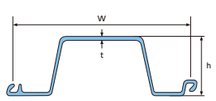
E.g. Sea wall

Steel sheet pile cell

● In the case of construction of a revetment at a seaside where a week layer exists, the improvement of soil is eliminated by embedding sheet piles into the load-bearing layer—unlike a concrete caisson or stone revetment. This is an environmentally friendly method. (Refer to pages 29 to 31.)



Product lineup

		Shape	Type	Moment of inertia	Section modulus	Unit mass		Maximum length	Grade									
									JIS A 5523			JIS A 5528		EN10248			ASTM	
				I (cm^4/m)	Z(cm^3/m)	W (kg/m^2)		L (m)	SYW295	SYW390	SYW430	SY295	SY390	S270GP	S355GP	S430GP	A572 Gr.50	A992
Hat-type sheet piles	Hat W = 900 mm		NS-SP-10H	10,500	902	96		29.5*2	✓	✓	–*4	–	–	–*4	–*2	–*4	✓*2	–
			NS-SP-25H	24,400	1,610	126		29.5*2	✓	✓*1	✓*1	–	–	–*4	–*2	–*4	✓*2	–
			NS-SP-45H	45,000	2,450	163		24*1*2	✓	✓	✓*1	–	–	–*1	–*2	–*2	–*4	–
			NS-SP-50H	51,100	2,760	186		23.5*1*2	✓*1	✓*1	✓*1	–	–	–*1	–*2	–*2	–*4	–
	Hat+H W = 900 mm		NS-SP-10H+HY NS-SP-25H+HY	113,400 to 1,285,800	3,240 to 19,280	196 to 490		29.5*2	Please refer to “NS-SP-10H”and “NS-SP-25H”. H-shapes is also available JIS, ASTM and EN.*2									
	Hat + (Hat+H) W = 900 mm		NS-SP-10H+HY	61,900 to 289,700	1,770 to 5,320	146 to 218		29.5*2										
Straight web-type sheet piles	Straight web W = 500 mm		NS-SP-FL	396	89	123		38*2	✓	✓	–*4	✓	✓	✓*2*3	✓*2	–*4	✓*2	✓*2
			NS-SP-FXL	570	121	154		38*2	✓	✓	–*4	✓	✓	✓*2	✓*2	–*4	✓*2	✓*2
U-type sheet piles	U-type W = 600 mm		NS-SP-Ⅱw	13,000	1,000	103		24.5*2	✓	✓	–*4	✓	✓	✓*1*2*3	✓*1*2*3	–*4	✓*2	–
			NS-SP-Ⅲw	32,400	1,800	136		24.5*2	✓	✓	–*4	✓	✓	✓*1*2*3	✓*1*2*3	–*4	✓*2	–
			NS-SP-Ⅳw	56,700	2,700	177		24.5*2	✓	✓	–	✓	✓	✓*1*2*3	✓*1*2	–*4	✓*2	–
	W = 500 mm		NS-SP-VL	63,000	3,150	210		24.5*2	✓	✓	–	✓	✓	✓*1*2*3	✓*2*3	–*4	✓*2	–
			NS-SP-VIL	86,000	3,820	240		23.5*2	✓	✓	–	✓	✓	✓*1*2*3	✓*2*3	–*4	✓*2	–
	W = 400 mm		NS-SP-Ⅲ	16,800	1,340	150		24.5*2	✓	✓	–*4	✓	✓	–*4	✓*1*2	✓*1*2	✓*1*2	–
			NS-SP-Ⅳ	38,600	2,270	190		24.5*2	✓	✓	–*4	✓	✓	–*4	✓*1*2	✓*1*2	✓*1*2	–
NS-SP-J	NS-SP-J W = 600 mm		NS-SP-J	12,090	1,175	145		24.5*2	✓	✓	–	✓	✓	✓*3*4	✓*4	–*4	✓*2	–

*1) Please contact us detail in advance to order.
*2) Tolerance of dimension based on JIS standard (refer to page 11)
*3) Mechanical property of elongation based on JIS standard (refer to page 11)
*4) Please contact us availability.

Grade and tolerances

JIS A 5523 : 2021 Weldable hot-rolled steel sheet piles
JIS A 5528 : 2021 Hot-rolled steel sheet piles

■ Chemical composition of the ladle analysis

Classification	Grade	Chemical composition(%)						Ceq.(%)
		C	Si	Mn	P	S	N	Ceq.
Weldable hot rolled steel sheet piles	SYW295	0.18max.	0.55max.	1.50max.	0.040max.	0.040max.	0.0060max.	0.44max.
	SYW390							0.45max.
Hot rolled steel sheet piles	SY295	—	—	—	0.040max.	0.040max.	—	—
	SY390							

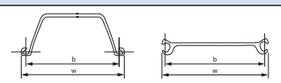
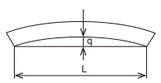
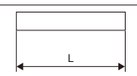
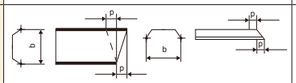
Note: Ceq.=C+Mn／6+Si／24+Ni／40+Cr／5+Mo／4+V／14

■ Mechanical properties

Standard	Classification symbol	Yield point N/mm²	Tensile Strength N/mm²	Test Piece	Elongation %	Charpy absorbed energy, J				Type and direction of test piece
						Test temperature (℃)	Standard size test specimen	Sub-size test specimen		
							10×10mm	10×7.5mm	10×5mm	
Weldable hot rolled steel sheet piles JIS A 5523	SYW295	295min.	450min.	No.1A	18min.	0	43min.	32min.	22min.	V notch in rolling direction
				No.14B	24min.					
	SYW390	390min.	490min.	No.1A	16min.					
				No.14B	20min.					
Hot rolled steel sheet piles JIS A 5528	SY295	295min.	450min.	No.1A	18min.	—	—	—	—	—
				No.14B	24min.					
	SY390	390min.	490min.	No.1A	16min.					
				No.14B	20min.					

Note: Chemical composition and mechanical properties conform to JIS A 5523:2021 or JIS A 5528:2021.
N is shown by total in accordance with section 5. Note 2 of JIS A 5523:2021.

■ Tolerances

Items		JIS A 5523, JIS A 5528 straight type	JIS A 5523 U-type	JIS A 5523 Hat-type	JIS A 5528 U-type
Width		± 4 mm	± 1 %b 2w, 3w, 4w + 6 mm − 5 mm	+ 10 mm − 5 mm	
Height		—	± 4 %	± 4 %	
Thickness		+ 1.5 mm − 0.7 mm	t < 10 mm + 1.0 mm − 0.3 mm 10 ≦ t < 16 mm + 1.2 mm − 0.3 mm t ≧ 16 mm + 1.5 mm − 0.3 mm	t < 10 mm ± 1.0 mm 10 ≦ t < 16 mm ± 1.2 mm t ≧ 16 mm ± 1.5 mm	
Straightness		(Deflection) L ≦ 10 m L × 0.15% L > 10 m (L−10) × 0.10% + 15 mm (Camber) L ≦ 10 m L × 0.20% L > 10 m (L−10) × 0.20% + 20 mm	(Deflection) L × 0.10% max 20 mm (Camber) L × 0.20% max 20 mm	(Deflection) L ≦ 10 m L × 0.12% L > 10 m (L−10) × 0.10% + 12 mm (Camber) L ≦ 10 m L × 0.25% L > 10 m (L−10) × 0.20% + 25 mm	
Length		+ Not specified − 0 mm			
Squareness of ends		4%b	4%b	4%b	
Overall width difference		—	Within 1 m of the end part in the length direction, the difference between the maximum and minimum of the overall width is 4 mm or under.	—	
End deflection		—	Within 1 m of the end part in the length direction, the end deflection is 1.5 mm or under.	—	
Coupling mating joint angle	—	—	≧ 6°	≧ 4°	—

BS EN 10248-1 : 2023

Hot-rolled steel sheet piles
Part 1. Technical delivery conditions

■ Chemical composition of the ladle analysis

Steel name	Chemical composition in % by mass max[1]								
	C	Mn	Si	P	S	N[1]	Cu	Other[1]	CEV[1]
S270GP	0.18	1.50	-	0.040	0.040	0.012	0.55	-	0.40
S350GP	0.20[1]	1.60	0.55	0.040	0.040				0.47
S430GP		1.70		0.035	0.035				0.49

1) See the specific limitation in the standard.

■ Mechanical properties[1]

Steel name	Minimum yield strength (N/mm²)	Minimum tensile strength (N/mm²)	Minimum elongation on a gauge length of $L_0 = 5.65\sqrt{S_0}$ A%	Minimum impact energy[1]	
				Testing temperature ℃	J Joules
S270GP	270	410	24	20	27
S355GP	355	480	22	0	27
S430GP	430	510	19	0	27

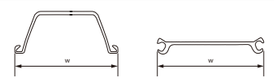
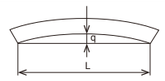
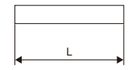
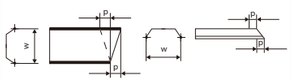
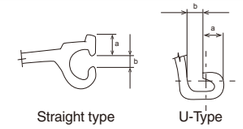
1) See the specific limitation in the standard.

* Please contact us in advance.

BS EN 10248-2 : 2024

Hot-rolled sheet piling of non-alloy steel
Part 2. Tolerances regarding shape and dimensions

■ Tolerances

Item		BS EN 10248-2
Width		± 2% w
Height		h ≦ 200 ± 4 mm h > 200 ± 5 mm
Thickness		t ≦ 8.5 −0.5 t > 8.5 −6 % t
Straightness		≦ 0.2 % L
Length		± 200
Squareness of ends		± 2%w
Interlocks of the profile	 Straight type U-Type	(straight type) a − b ≧ 6 (U-type) a − b ≧ 4
Mass		± 5%

Please contact us in case above tolerances are applied.

ASTM A572 / A572M-21

High-strength low-alloy columbium-vanadium structural steel

■ Chemical composition of the ladle analysis

Grade	Chemical composition % max				
	C	Mn	Si	P[1]	S[1]
50	0.23	1.35[1]	0.40	0.030	0.030

1) See the specific limitation in the standard.

■ Mechanical properties

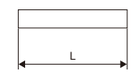
Grade	Minimum yield strength	Minimum tensile strength	Minimum elongation(%)
50	50Ksi (345MPa)	65Ksi (450MPa)	In 8 in. (200 mm) : 18 In 2 in. (50 mm) : 21

* Please contact us in advance.

ASTM A6 / A6M-24a

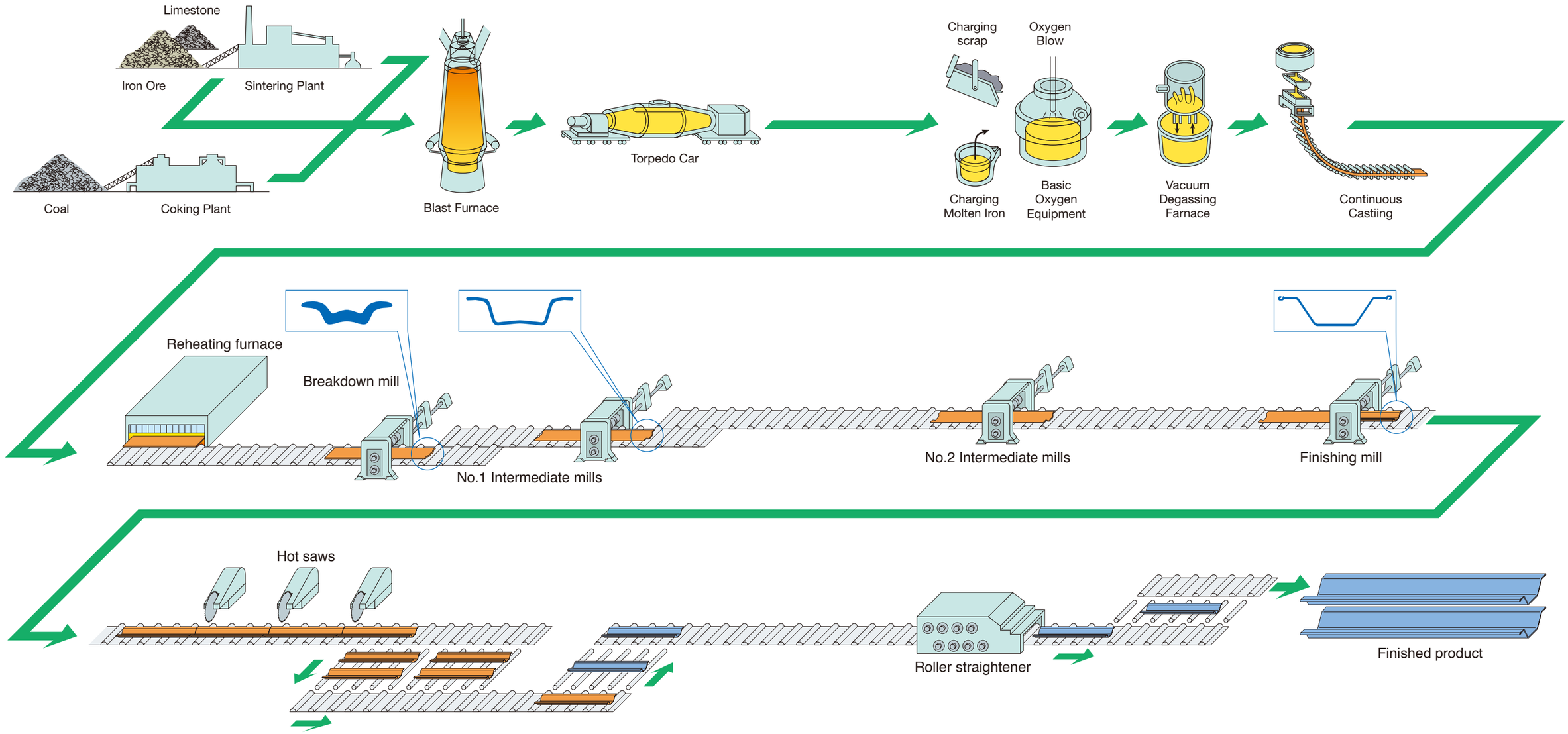
Standard specifications for general requirements for rolled structural steel bars, plates, shapes, and sheet pilings.

■ Tolerances

Item		ASTM A6
Length		+ 125 mm − 0 mm
Mass		± 2.5%

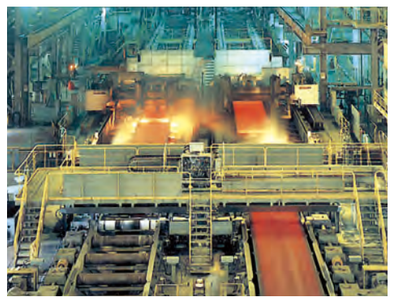
Please contact us in case above tolerances are applied.

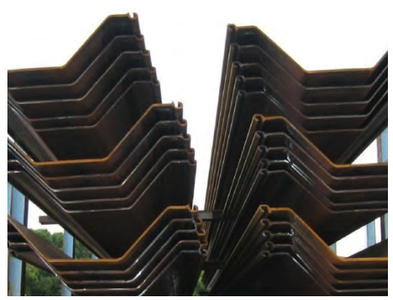
Production process




Blast furnace


Basic-oxygen furnace


Continuous caster


Finished product


After installation

Engineering services

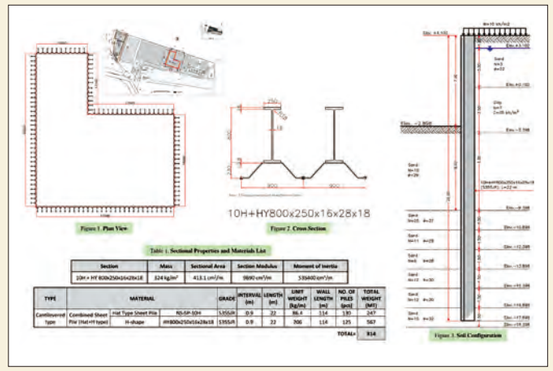
NIPPON STEEL is the world's leading supplier of hot-rolled steel sheet piles. In addition to the supply of products, We provide the complimentary engineering support listed below in response to the request of our customer. The engineering team from NIPPON STEEL and overseas offices can cover the global market.

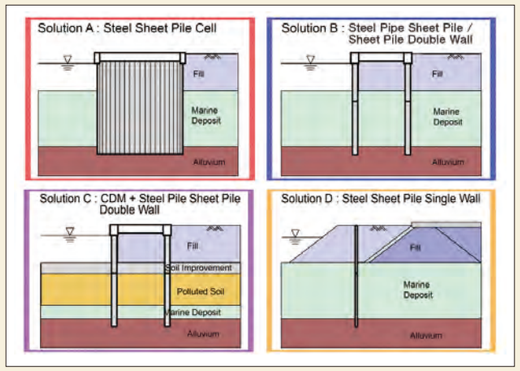
- Design proposals related to the basic / detailed design of structures (temporary / permanent) using steel sheet pile products.
- Supply of information on the construction method of structures using steel sheet piles.
- Design proposals related to the method to prevent corrosion of steel sheet pile products.
- Instructions on how to manufacture fabricated products, etc.

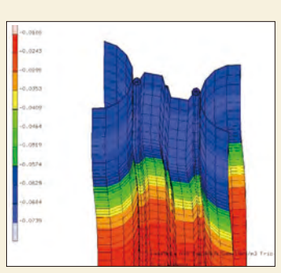
Note : This is a part of complimentary engineering support for reference of our customer. The responsible judgment is up to the customer.

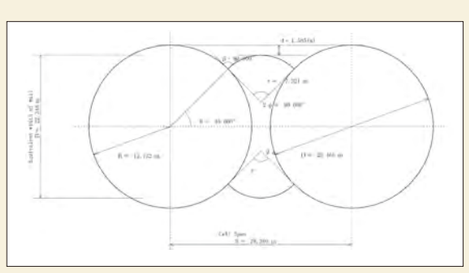
Design proposal

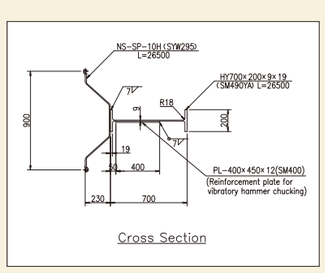
Based on the design conditions obtained from the customer and our numerous design records, we can provide an optimum design plan.











Proposal of method to prevent corrosion

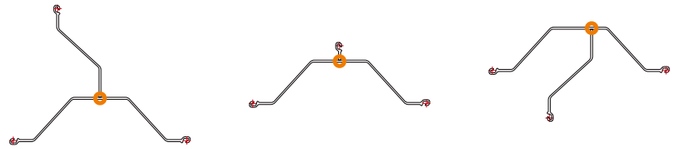
With long-standing experience, we are able to provide various kinds of recommendations.

Proposal of construction method

Based on past achievements, we can provide various recommendations, including those regarding the selection of the most-optimum construction machine according to soil conditions.

Design and Instruction for fabrication

NIPPON STEEL can provide design proposal of corner section and also can provide instruction of fabrication for Hat+H at site.



Instruction of fabrication

Standardization

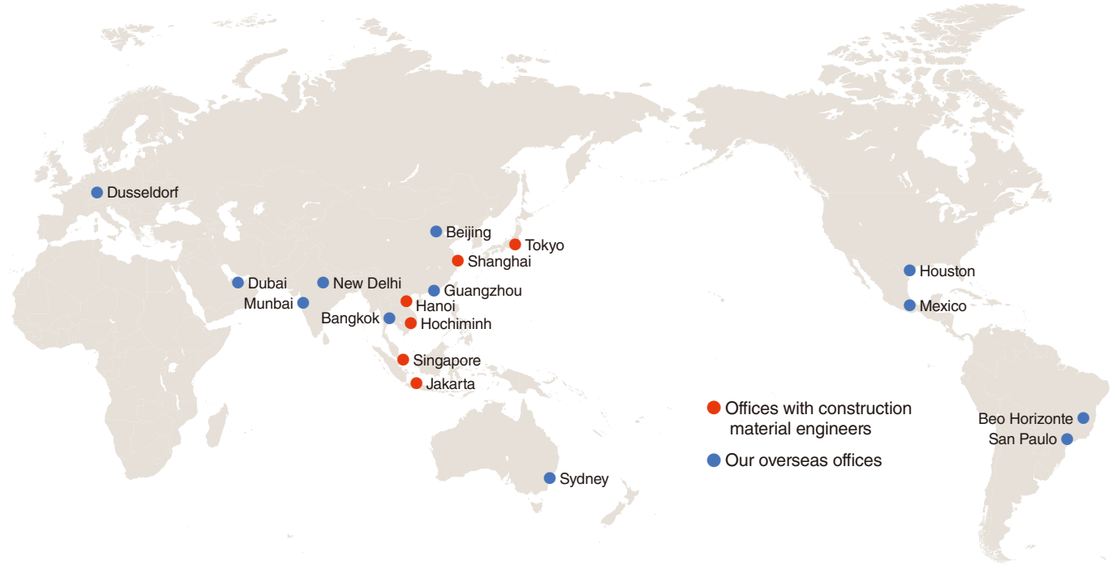
We have standardized material specification and design criteria

UTC-NIPPON STEEL
Design manual
Vietnam

ITB-NIPPON STEEL
Guideline
Indonesia

Map of offices

Through the offices below, we review various techniques, and we hold seminars, exhibitions, and construction demonstrations, etc., all over the world.



ProStruct™ Open your future with Structural Steel & Technology

Hat-type sheet piles

● Superb drivability

The large sectional area of the Hat-type sheet pile realizes superior drivability.

● High structural reliability

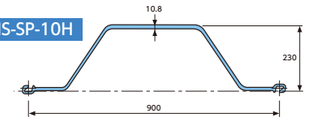
No reduction is required in sectional properties to consider the possible lack of shear force transmission at the interlocks, which is true for U-type steel sheet piles.

● Excellent cost-effectiveness

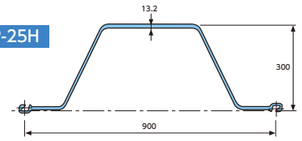
The amount of steel per unit wall can be reduced, resulting in improved total cost.

■ Shapes

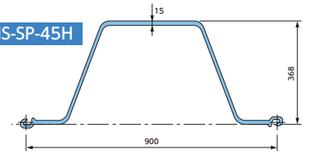
NS-SP-10H



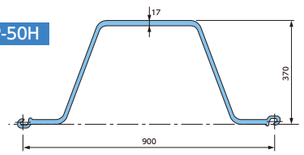
NS-SP-25H



NS-SP-45H

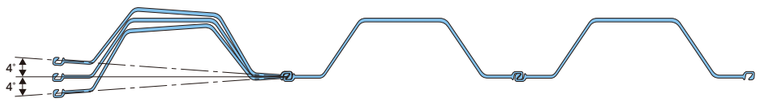


NS-SP-50H



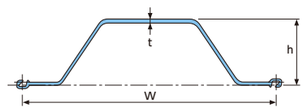
■ Deviation angle

Each interlock allows for a certain rotation. The minimum angle of coupling mating joint (the interlock swing) for the combination of the identical versions of Hat-type sheet piles is shown in the figure below.



■ Compatibility

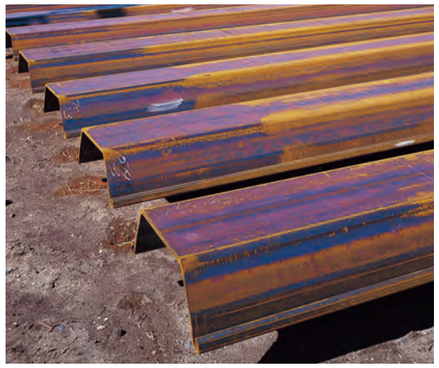
NS-SP-10H — NS-SP-25H — NS-SP-45H — NS-SP-50H



■ Sectional properties

Type	Dimension			Per pile				Per 1 m of pile wall width			
	Effective width W mm	Effective height h mm	Thickness t mm	Sectional area cm²	Moment of inertia cm⁴	Section modulus cm³	Unit mass kg/m	Sectional area cm²/m	Moment of inertia cm⁴/m	Section modulus cm³/m	Unit mass kg/m²
NS-SP-10H	900	230	10.8	110.0	9,430	812	86.4	122.2	10,500	902	96.0
NS-SP-25H	900	300	13.2	144.4	22,000	1,450	113	160.4	24,400	1,610	126
NS-SP-45H	900	368	15.0	187.0	40,500	2,200	147	207.8	45,000	2,450	163
NS-SP-50H	900	370	17.0	212.7	46,000	2,490	167	236.3	51,100	2,760	186

U-type sheet piles

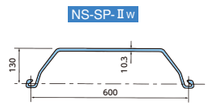


● U-type sections have been widely used for various types of permanent and temporary structures, and are one of the most familiar sheet piles among both designers and users.

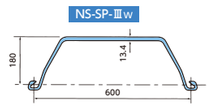
● NS-SP-Ⅲ, Ⅳ, Ⅴ$_L$ and Ⅶ$_L$ are solidly designed. These sections are especially suitable for repeated use, and have acquired high market acceptance from users.

■ Shapes

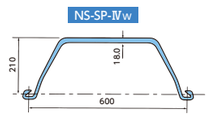
NS-SP-Ⅱw



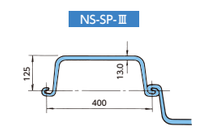
NS-SP-Ⅲw



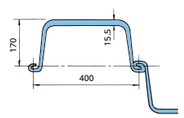
NS-SP-Ⅳw



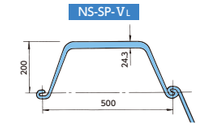
NS-SP-Ⅲ



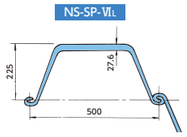
NS-SP-Ⅳ



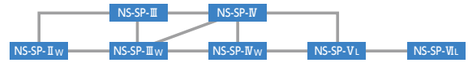
NS-SP-Ⅴ$_L$



NS-SP-Ⅶ$_L$

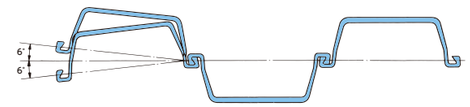


■ Compatibility

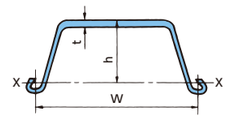


■ Deviation Angle

Each interlock allows a certain rotation. The minimum angle of deviation (the interlock swing) for the combination of the identical versions of U-type sheet piles is shown in the figure below.



■ Sectional properties



Type	Dimension			Per pile				Per 1 m of pile wall width			
	Effective width W mm	Effective height h mm	Thickness t mm	Sectional area cm²	Moment of inertia cm⁴	Section modulus cm³	Unit mass kg/m	Sectional area cm²/m	Moment of inertia cm⁴/m	Section modulus cm³/m	Unit mass kg/m²
NS-SP-Ⅲ	400	125	13.0	76.42	2,220	223	60.0	191.0	16,800	1,340	150
NS-SP-Ⅳ	400	170	15.5	96.99	4,670	362	76.1	242.5	38,600	2,270	190
NS-SP-Ⅴ$_L$	500	200	24.3	133.8	7,960	520	105	267.6	63,000	3,150	210
NS-SP-Ⅶ$_L$	500	225	27.6	153.0	11,400	680	120	306.0	86,000	3,820	240
NS-SP-Ⅱw	600	130	10.3	78.70	2,110	203	61.8	131.2	13,000	1,000	103
NS-SP-Ⅲw	600	180	13.4	103.9	5,220	376	81.6	173.2	32,400	1,800	136
NS-SP-Ⅳw	600	210	18.0	135.3	8,630	539	106	225.5	56,700	2,700	177

Hat-type and H-shape combined high stiffness steel sheet piles

Features

Availability of numerous sectional properties

Hat-type and H-shape combined high stiffness steel sheet piles come in combination of Hat-type sheet piles which have four types and H-shape sections which have many types. Eventually they provide more than 200 types of economical properties. (Section modulus per meter of wall : Approx. 1,770 to 19,280cm^3/m)

Ease of fabrication

It is easy to fabricate Hat-type and H-shape combined high stiffness steel sheet piles by combining Hat-type and H-shape with intermittent fillet welding. Welding can be carried out at the site or the nearby yard or shop.

Excellent cost-effectiveness

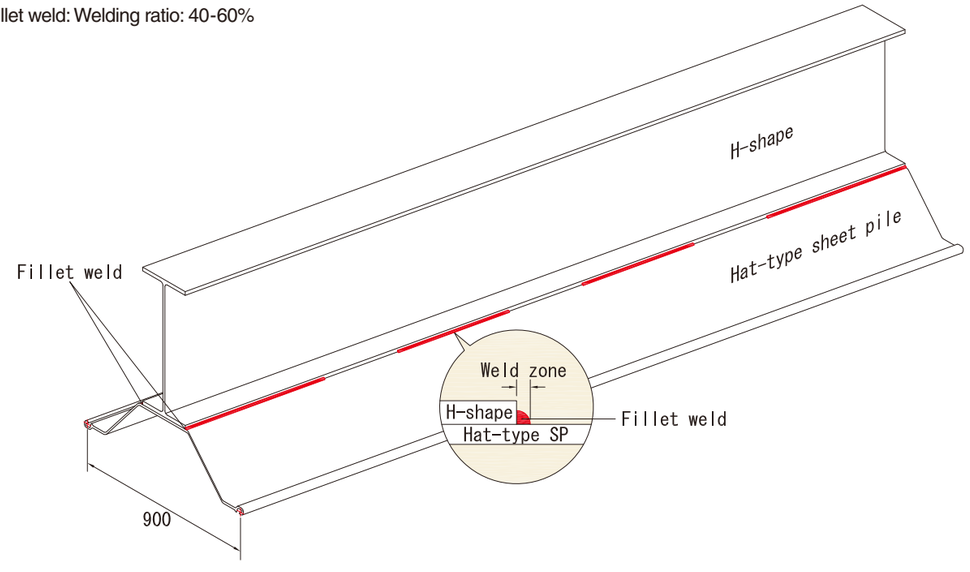
From the viewpoint of design for the Hat-type and H-shape combined high stiffness steel sheet pile, Hat-type functions as a continuous wall to sustain soil and water, and H-shape functions as a structural member to bear the bending moment. This makes it possible to use low-cost H-shape up to 50 to 70% of weight as well as avoiding use of expensive connectors to connect a sheet pile and a section.

Ease of Installation

An ordinary vibratory hammer is directly applicable for driving. The Hat-type and H-shape combined high stiffness steel sheet pile, having higher moment of inertia per pile compared with Z-type and other type piles, is very easy to work with.

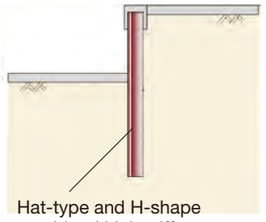
Shape

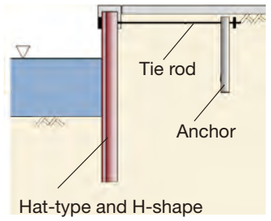
Fillet weld: Welding ratio: 40-60%



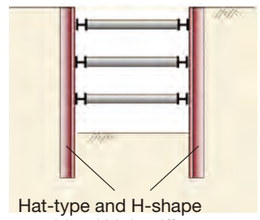
Examples of application

- Quay walls of port facilities and shipyard dock walls
- Temporary and permanent earth-retaining wall structures for open-cut tunnels
- Earth-retaining walls for high embankments


Hat-type and H-shape combined high stiffness steel sheet piles



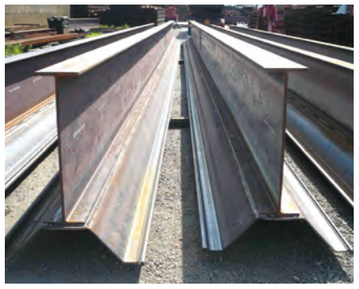
Hat-type and H-shape combined high stiffness steel sheet piles


Hat-type and H-shape combined high stiffness steel sheet piles

Fabrication method

Hat-type and H-shape combined high stiffness steel sheet piles can be easily fabricated on construction site or at a nearby yard or shop.
We have prepared manuals for fabrication and can provide on-site instruction.

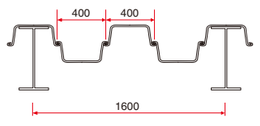
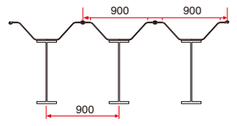
Manual for fabrication

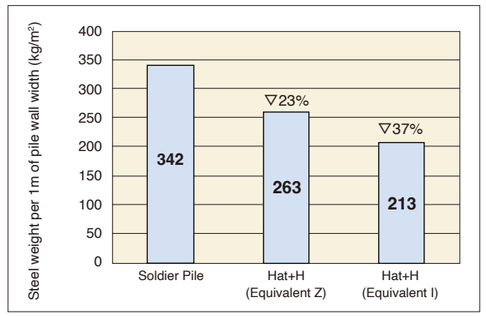


Easy to fabricate on site

Trial calculation example of benefit in the case of the application of Hat-type and H-shape combined high stiffness steel sheet piles compared with existing temporary retaining walls

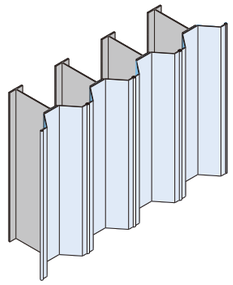
The following shows the comparison result between soldier piles, which are generally used as steel material for temporary retaining walls in Southeast Asia, and Hat-type and H-shape combined high stiffness steel sheet piles.

Item	Soldier Pile Built-up section	Hat+H Composite section
Outline		
Section	H-shape : UB610×229×243 U-type steel sheet pile : NS-SP-IV Section Modulus Z=6,264cm^3/m Moment of Inertia I=168,000cm^4/m	Equivalent Z=6,810cm^3/m NS-SP-10H+H750×250×12×22 Equivalent I=208,200cm^4/m NS-SP-10H+H600×200×12×16

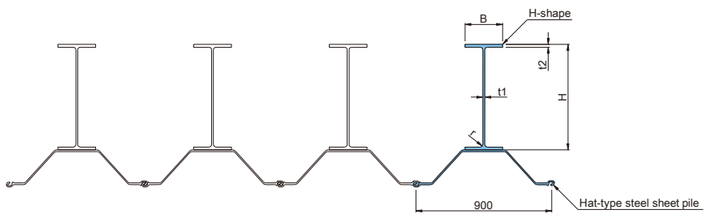


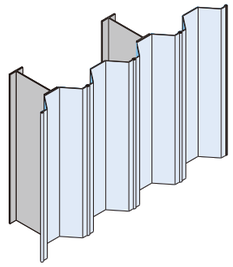
* Trial calculation by NIPPON STEEL

Sectional properties

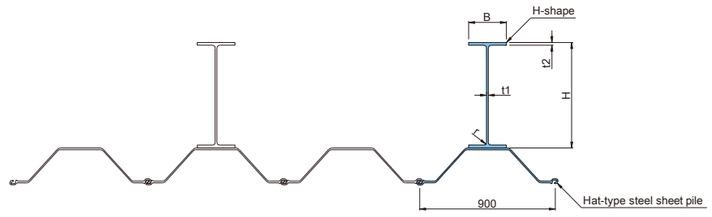


— Basic type —





— Alternated type —



Hat type sheet pile	NSHYPER BEAM ™					Mass per m^2 of wall	Sectional area	Section modulus	Moment of inertia
	H	B	t1	t2	r	kg/m^2	cm^2/m	cm^3/m	cm^4/m
NS-SP-10H	400	200	9	22	13	202	257	3,240	113,400
	400	200	12	22	13	212	269	3,410	117,100
	450	200	9	19	13	196	249	3,280	128,300
	450	250	9	19	13	213	271	3,790	143,500
	450	250	9	22	13	225	287	4,160	153,800
	450	250	12	25	13	248	316	4,700	167,700
	450	250	12	28	13	260	332	5,040	176,500
	500	200	12	19	13	212	270	3,860	160,200
	500	200	12	22	13	222	282	4,170	170,100
	500	200	12	25	13	232	295	4,470	179,500
	500	250	12	22	13	240	307	4,800	189,700
	500	250	12	25	13	254	323	5,180	201,000
	500	250	12	28	13	266	339	5,550	211,800
	600	200	12	16	13	213	271	4,270	208,200
	600	200	12	19	13	223	283	4,640	222,400
	600	200	12	22	13	233	296	5,010	236,000
	600	200	12	25	13	242	308	5,350	248,600
	600	200	12	28	13	252	321	5,720	261,900
	600	250	12	19	13	239	304	5,280	246,600
	600	250	12	22	13	252	320	5,740	262,900
	600	250	12	25	13	264	336	6,190	278,900
	600	250	12	28	13	276	352	6,630	294,500
	600	250	16	28	13	295	376	7,010	304,800
	600	250	16	32	13	312	397	7,570	323,900
	700	200	12	25	18	254	323	6,370	334,800
	700	250	12	22	18	263	335	6,810	353,900
	700	250	12	25	18	276	351	7,320	374,900
	700	250	14	22	18	275	350	7,070	362,400
	700	250	14	25	18	287	365	7,580	383,000
	700	250	14	28	18	299	381	8,080	403,300
	750	250	14	22	18	280	357	7,640	414,700
	750	250	14	25	18	293	373	8,200	438,900
	750	250	14	28	18	305	389	8,730	461,700
NS-SP-10H	800	250	14	22	18	287	365	8,240	471,700
	800	250	14	25	18	299	381	8,820	498,400
	800	250	14	28	18	312	397	9,370	523,600
	800	250	16	22	18	299	382	8,570	484,200
	800	250	16	25	18	313	398	9,140	510,500
	800	250	16	28	18	325	413	9,690	535,400
	800	250	16	32	18	340	434	10,440	568,900
	850	250	14	22	18	293	373	8,840	532,300
	850	250	16	22	18	307	391	9,220	547,600
	850	250	16	25	18	319	406	9,810	576,400
	850	250	16	32	18	347	443	11,200	642,900
	900	250	16	19	18	302	384	9,240	582,000
	900	250	16	22	18	314	400	9,890	615,800
	900	250	16	25	18	326	415	10,520	648,000
	900	250	16	28	18	338	431	11,140	680,000
	950	250	16	22	18	320	409	10,570	688,700
	950	250	16	25	18	333	424	11,230	724,400
	950	250	16	28	18	345	440	11,890	759,900
	950	250	19	25	18	357	454	11,870	752,500
	950	250	19	28	18	368	470	12,530	787,400
	1000	250	16	22	18	328	417	11,270	766,300
	1000	250	16	25	18	340	433	11,980	806,700
	1000	250	19	25	18	365	465	12,680	838,900
	1000	250	19	28	18	377	480	13,360	877,300
NS-SP-25H	1000	250	19	25	18	395	503	13,770	973,700
	1000	250	19	28	18	407	518	14,470	1,014,600
	1000	250	19	32	18	423	539	15,400	1,068,100
	1000	300	16	28	18	407	518	15,180	1,064,500
	1000	300	16	32	18	426	543	16,330	1,129,800
	1000	300	19	28	18	432	549	15,940	1,099,800
	1000	300	19	32	18	450	574	17,080	1,164,000
	1000	300	19	36	18	470	599	18,180	1,225,200
	1000	300	19	40	18	490	624	19,280	1,285,800

The regular size mentioned in the table are examples. More economical size can be available depending on design conditions(corrosion allowance, yield strength,etc)
Please contact us for more details.
The values shown in the table may contain errors of less than 1%.

Hat type sheet pile	NSHYPER BEAM ™					Mass per m^2 of wall	Sectional area	Section modulus	Moment of inertia
	H	B	t1	t2	r	kg/m^2	cm^2/m	cm^3/m	cm^4/m
NS-SP-10H	400	200	9	22	13	149	190	1,770	61,900
	400	200	12	22	13	154	196	1,860	63,800
	450	200	9	19	13	146	186	1,770	69,400
	450	250	9	19	13	154	196	2,030	77,000
	450	250	9	22	13	160	204	2,220	82,100
	450	250	12	25	13	172	219	2,500	89,100
	450	250	12	28	13	178	227	2,670	93,500
	500	200	12	19	13	154	196	2,060	85,400
	500	200	12	22	13	159	202	2,210	90,300
	500	200	12	25	13	164	209	2,370	95,000
	500	250	12	22	13	168	215	2,530	100,100
	500	250	12	25	13	175	223	2,720	105,700
	500	250	12	28	13	181	230	2,910	111,100
	600	200	12	16	13	154	196	2,240	109,300
	600	200	12	19	13	159	203	2,430	116,400
	600	200	12	22	13	164	209	2,610	123,200
	600	200	12	25	13	169	215	2,790	129,600
	600	200	12	28	13	174	222	2,970	136,200
	600	250	12	19	13	168	213	2,750	128,500
	600	250	12	22	13	174	221	2,980	136,700
NS-SP-10H	600	250	12	25	13	180	229	3,210	144,700
	600	250	12	28	13	186	237	3,430	152,500
	600	250	16	28	13	195	249	3,620	157,600
	600	250	16	32	13	204	260	3,910	167,200
	700	200	12	25	18	175	223	3,280	172,600
	700	250	12	22	18	179	229	3,510	182,200
	700	250	12	25	18	186	237	3,760	192,700
	700	250	14	22	18	185	236	3,640	186,400
	700	250	14	25	18	192	244	3,890	196,800
	700	250	14	28	18	198	252	4,150	206,900
	750	250	14	22	18	188	240	3,920	212,600
	750	250	14	25	18	194	248	4,200	224,700
	750	250	14	28	18	200	256	4,460	236,100
	800	250	14	22	18	192	244	4,210	241,100
	800	250	14	25	18	198	252	4,500	254,400
	800	250	14	28	18	204	259	4,780	267,100
	800	250	16	22	18	198	252	4,380	247,400
	800	250	16	25	18	204	260	4,670	260,500
	800	250	16	28	18	210	268	4,940	273,000
	800	250	16	32	18	218	278	5,320	289,700

The regular size mentioned in the table are examples. More economical size can be available depending on design conditions(corrosion allowance, yield strength,etc)
Please contact us for more details.
The values shown in the table may contain errors of less than 1%.

ProStruct™ Open your future with Structural Steel & Technology

NS-SP-J

● Close-proximity installation

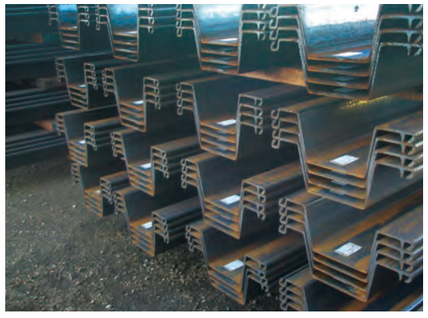
NS-SP-J piles can be installed in close proximity to existing structures, permitting the construction of retaining walls abutting site boundaries and making maximum use of the site area.

● 100% interlock integrity

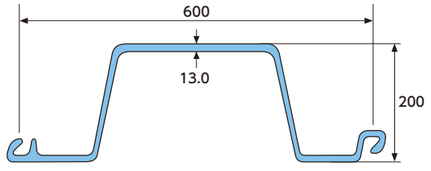
As interlocks are located on the outermost side of the wall, there is no need to consider the reduction of sectional properties due to slip on interlocks, and this permits economical design.

● Cost-saving and Work-shortening of Temporary Work

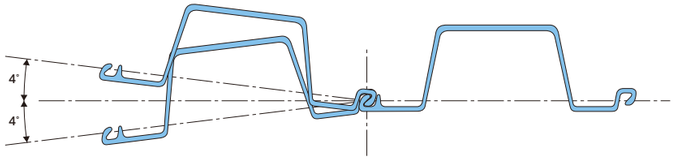
Cost-saving and the shortening of temporary work time
Compared to conventional steel sheet piles for temporary work with an effective width of 400 mm, NS-SP-J has an effective width of 600 mm. This makes it possible to reduce the number of installed piles, with less cost and improved water tightness.



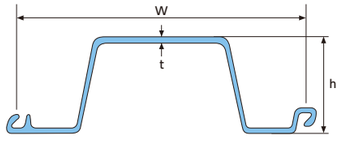
Shapes



Deviation angle



* NS-SP-J can be interlocked with some U-type sheet piles. The compatible types for interlocking depend on the usage conditions at the site. Please consult NIPPON STEEL for details.



Sectional properties

Type	Dimension			Per pile				Per 1 m of pile wall width			
	Effective width W mm	Effective height h mm	Thickness t mm	Sectional area cm²	Moment of inertia cm⁴	Section modulus cm³	Unit mass kg/m	Sectional area cm²/m	Moment of inertia cm⁴/m	Section modulus cm³/m	Unit mass kg/m²
NS-SP-J	600	200	13.0	111.2	7,250	705	87.3	185.3	12,090	1,175	145

Straight web-type sheet piles

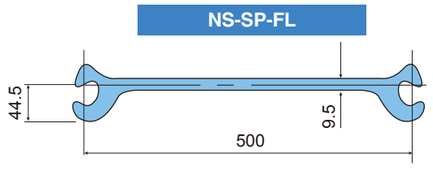
● High joint strength

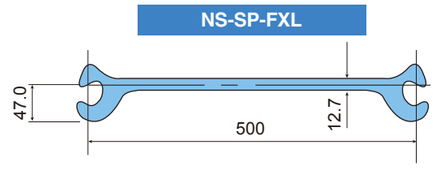
This type of sheet pile boasts extremely high tensile strength at its interlocking sections, up to 5.88 MN per linear meter of joint length, and is suited for use in cellular-type structures, such as quay walls, manmade island seawalls, cofferdams, and other similar projects.
In addition, we can provide the longest product currently possible: a maximum of 38.0 m.

● Large deviation angle

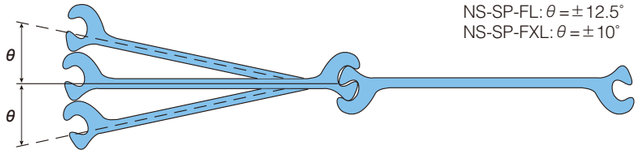
This sheet pile has large deviation angle at interlocks (the interlock swing), the maximum angles for the combination of the identical types of straight web-type sheet piles are respectively 10.0 and 12.5.

Shapes





Deviation angle



NS-SP-FL: $\theta = \pm 12.5^\circ$
NS-SP-FXL: $\theta = \pm 10^\circ$

Joint strength

Type	Tensile strength (MN/m)
NS-SP-FL	3.92
NS-SP-FXL	5.88

Sectional properties

Type	Dimension			Per pile				Per 1 m of pile wall width			
	Effective width W mm	Effective height h mm	Thickness t mm	Sectional area cm²	Moment of inertia cm⁴	Section modulus cm³	Unit mass kg/m	Sectional area cm²/m	Moment of inertia cm⁴/m	Section modulus cm³/m	Unit mass kg/m²
NS-SP-FL	500	44.5	9.5	78.57	184	45.7	61.7	157.1	396	89	123
NS-SP-FXL	500	47.0	12.7	98.36	245	60.3	77.2	196.7	570	121	154

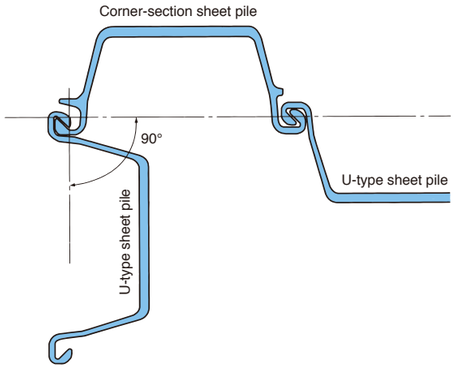
Corner section sheet piles: As rolls

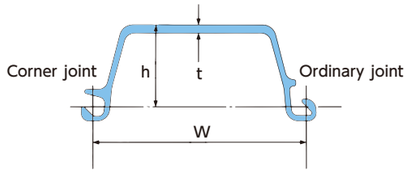
High reliability

- Corner-section sheet piles are a newly developed type produced by rolling, to replace the conventional T-shape corner-sheet piles produced by welding. Thus, these eliminate the need for welding and other fabrication processes and are far lighter in weight.
- For assembly, the conventional cast equipment can be used as-is.
- In particular, Larssen sheet piling has been adopted as a base for the shape of corner joints, in order to prevent detachment, and therefore, particularly, joint performance such as fitment and repetition endurance is excellent.

Shapes

NS-SP-CⅢ、NS-SP-CⅣ

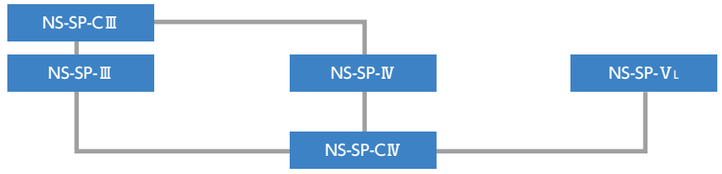




Sectional properties

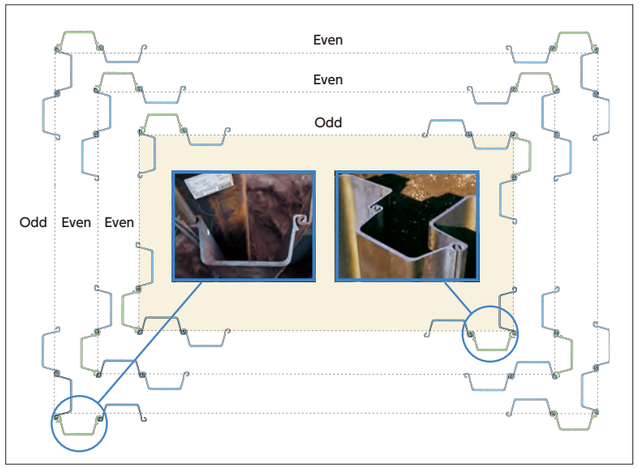
Type	Dimension			Per pile			
	Effective width W mm	Effective height h mm	Thickness t mm	Sectional area cm²	Moment of inertia cm⁴	Section modulus cm³	Unit mass kg/m
NS-SP-CⅢ	400	125	13.0	79.63	2,330	237	62.5
NS-SP-CⅣ	400	170	15.5	96.76	4,630	337	76.0

Compatibility



Installation

NS-SP-CⅢ、NS-SP-CⅣ



Sectional properties after corrosion

Steps to calculate sectional properties after corrosion;

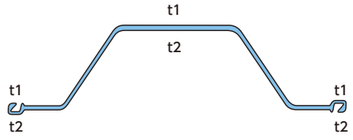
① Assume the corrosion rate and lifetime of the facility, and calculate the corrosion loss of the marine side t_1 (mm) and that of the land side t_2 (mm).

② Calculate the corrosion loss rate α (= t_2/t_1)

③ Using the corrosion loss of the marine side t_1 (mm) and the corrosion loss rate α , obtain the reduction ratio of the sectional properties η from the following graphs.

④ Calculate the sectional properties after corrosion loss, Z and I, by multiplying the sectional properties before corrosion loss, Zo and Io, by the reduction ratio η .

Section modulus $Z = Zo \times \eta$ Moment of inertia $I = Io \times \eta$



η : reduction ratio of sectional properties after corrosion (%)

t_1, t_2 : corrosion loss of marine side and land side (mm)

α : corrosion loss rate, $\alpha = t_2/t_1$

Note : Only the illustrated ranges are effective in the following graphs.

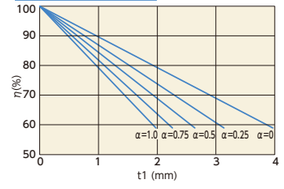
Io, Zo: Moment of inertia and section modulus without corrosion loss

η : Reduction ratio after corrosion

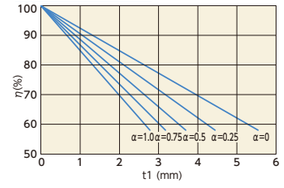
I, Z : Moment of inertia and section modulus after corrosion

Graphs for obtaining the reduction ratio of sectional properties, η

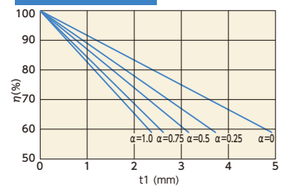
NS-SP-10H



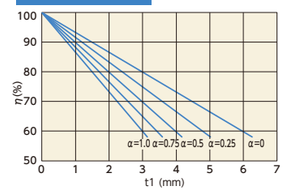
NS-SP-45H



NS-SP-25H



NS-SP-50H



Interlock integrity

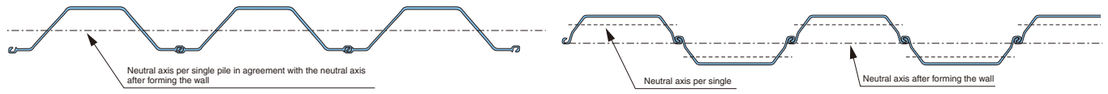
■ Advantage of no reduction of sectional properties due to interlock integrity

❶ Interlock integrity of sheet piles

When a wall using U-type steel sheet piles is subjected to bending due to soil pressure or other horizontal load, a large bending shear force occurs in the interlocks of the sheet piles because these interlocks are located at the center of the wall (neutral axis position).

In this case, If the shear force doesn't transmit sufficiently between the adjacent the interlocks slip from each other, and the moment of inertia and section modulus of the wall of the sheet piles are reduced. This can be referred to as "lack of interlock integrity". And the degree of reduction is expressed by reduction factor. In contrast, for a wall using Hat-type steel sheet piles, the reduction of sectional properties is not required because interlocks are located at the most outer edge of the wall, which means that the shear force does not occur in the interlocks.

Reduction factors of sectional properties from code to code. An example of the Eurocodes is shown below.



■ **Reduction factor of sectional properties due to the lack of interlock integrity**

Type of U-pile unit	Number of structural support levels	Highly unfavourable conditions		Unfavourable conditions		Favourable conditions	
		β_B	β_D	β_B	β_D	β_B	β_D
Singles or uncrimped doubles	0	0.40	0.30	0.50	0.35	0.60	0.40
	1	0.55	0.35	0.60	0.40	0.70	0.45
	>1	0.65	0.45	0.70	0.50	0.80	0.55
Crimped or welded doubles	0	0.70	0.60	0.75	0.65	0.80	0.70
	1	0.80	0.70	0.85	0.75	0.95	0.80
	>1	0.90	0.80	0.95	0.85	1.00	0.90

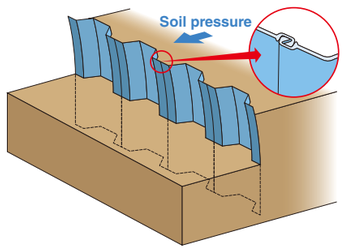
Where,

β_B: Factor accounting for the possible reduction of the section modulus of U-piles due to insufficient shear force transmission in the interlocks

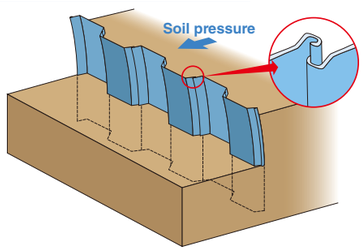
β_D: Factor accounting for the possible reduction of the moment of inertia of U-piles due to insufficient shear force transmission in the interlocks

Reference: UK National Annex to Eurocode, *3. Design of steel structures, Part 5: Piling* (NA + A1: 2012 to BS EN 1993-5: 2007)

Hat-type steel sheet pile



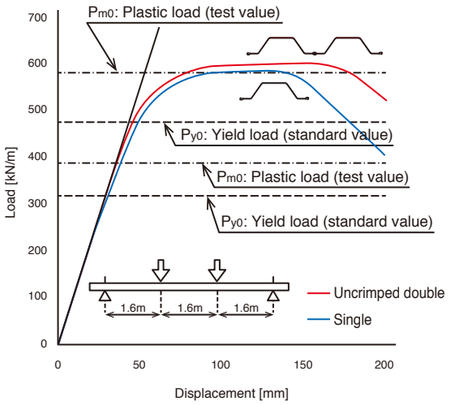
U-type steel sheet pile



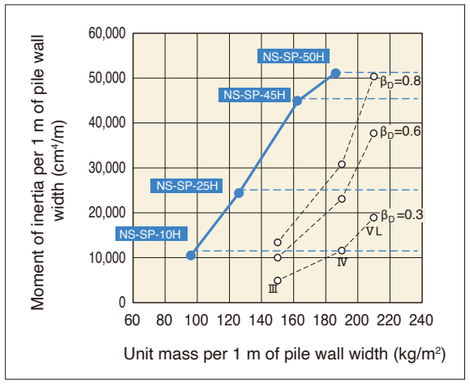
❷ Interlock integrity in Hat-type steel sheet piles

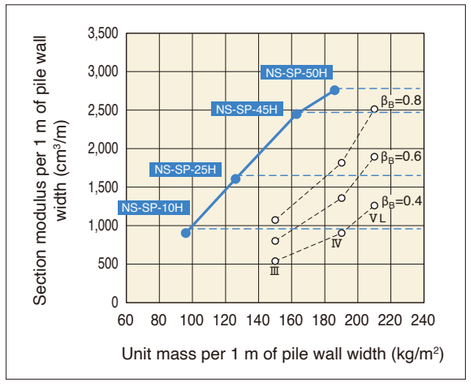
Bending tests for Hat-type steel sheet piles in the form of a wall as well as in the form of a single pile have been conducted. It is confirmed that the design values of the load-displacement relationship are in agreement with the experimental values. This demonstrates that the reduction of sectional properties is not required.

Quoted from the JASPP (Japanese Association for Steel Pipe Piles); "Hat-type sheet pile 900"



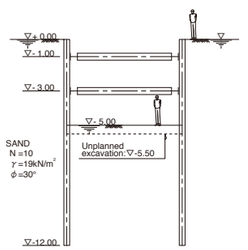
❸ Steel-weight comparison between U-type and Hat-type, the sectional properties of which are reduced using by interlock factors



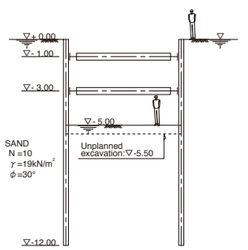


❹ Example of a trial design for temporary retaining walls

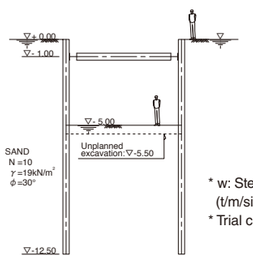
The reduction factor of U-type steel sheet piles is set as 0.45 for the moment of inertia, with 0.6 for the section modulus, in order to compare U-type and Hat-type using the same design conditions. NS-SP-25H (Hat-type) shows design results that are roughly equivalent to those of NS-SP-IV (U-type), and the number of short strut rows and the length of the steel sheet piles are mostly the same. However, the weight of NS-SP-25H (Hat-type) is 66% that of NS-SP-IV (U-type). When using NS-SP-45H (Hat-type), the working space increases during excavation with only one strut row, and the working efficiency of concrete structure fabrication is greatly improved, enabling a construction cost reduction for the concrete structure. Although the weight increases compared with NS-SP-25H, NS-SP-45H is still 89% that of NS-SP-IV (U-type), and thus a weight reduction benefit can be obtained.



【U-type(NS-SP-Ⅳ)】
w = 2.28 (t/m/side)
(1.00)



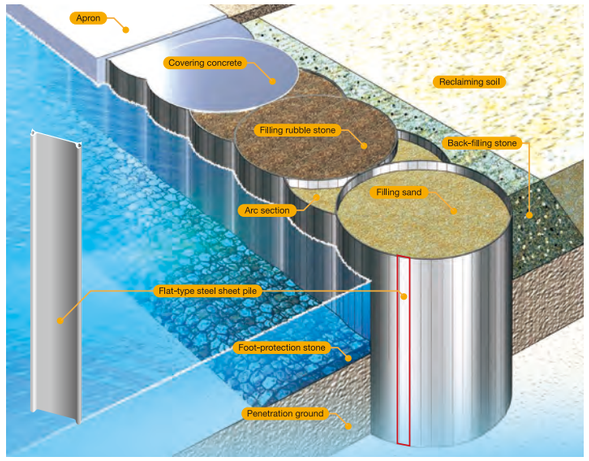
【Hat-type(NS-SP-25H)】
w = 1.51 (t/m/side)
(0.66)



【Hat-type(NS-SP-45H)】
w = 2.04 (t/m/side)
(0.89)

* w: Steel sheet pile weight (t/m/side)
* Trial calculation by us

Steel sheet pile cell structure



Features

Available for various soil conditions

It is widely applicable especially port and harbor structure in deep water because no auxiliary construction method is required and ground resistance at embeded part is utilized unlike concrete structure such as concrete caissons.

Various construction method

There are various construction method such as prefab, semi-prefab and in-situ type, and it can be chosen optimum construction method according to soil, hydrographic conditions and availability of equipment.

High-speed construction

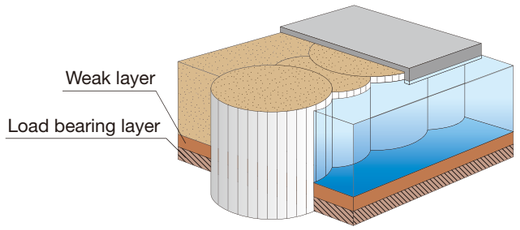
The prefabricated sheet pile method can cut construction time remarkably.

Environmentally friendly method

No soil improvement is needed in the case of sheet piles reaching the supporting layer, as the embedded part of the sheet pile can resist earth pressure.

Structural example

Circular cell

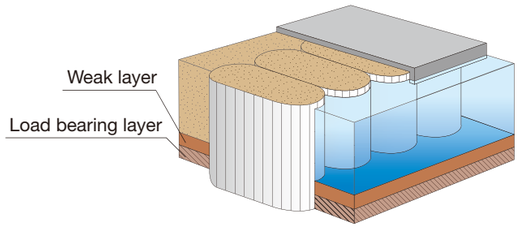


Circular cell is commonly used closed section structure consists of cyrindical and arc part, formed by straight web type sheet piles. This structure is suitable for underwater structure, such as revetment, quay, breakwaters, temporary cofferdam because the cylindrical cell becomes a stable structure after the filling.

Application : Seawall, Breakwater, Cofferdam, etc.

Applicable depth : 10~15m

Diaphragm cell

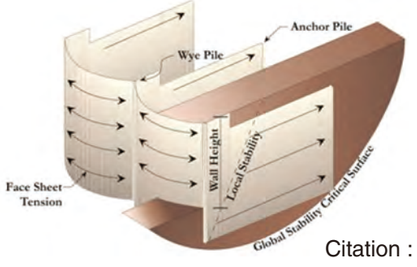


Diaphragm cell consists of bulk head and arc part, and usage of steel can be reduced compared with circular cell. This structure is especially suitable for artificially-excavated port on shore and shallow.

Application : Seawall, Cofferdam

Applicable depth : 15m~

Open cell

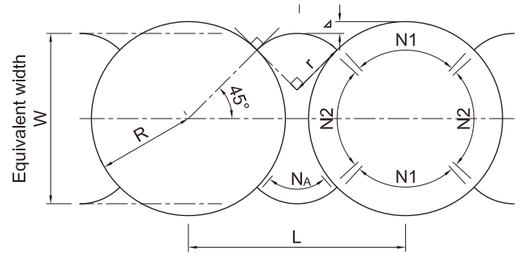


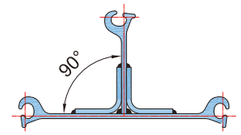
Open cell consists of front arc part and bulkhead as anchoring function and usage of steel is less than other cell structures because back side of bulkhead is not necessary on this structure.

Application : Seawall, Breakwater, Cofferdam

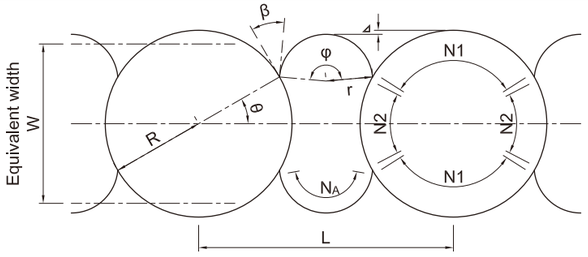
Citation : PND ENGINEERS, INC.

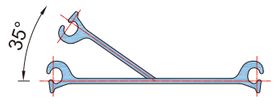
Example of layout





N (pcs)	N1 (pcs)	N2 (pcs)	N_A (pcs)	R (mm)	r (mm)	L (mm)	Δ (mm)	W (mm)
88	21	21	12	7,003	4,138	15,756	839	12,300
92	22	22	13	7,321	4,456	16,656	839	12,871
96	23	23	13	7,639	4,456	17,106	932	13,414
100	24	24	14	7,958	4,775	18,006	932	13,984
104	25	25	14	8,276	4,775	18,456	1,026	14,527
108	26	26	15	8,594	5,093	19,357	1,026	15,097
112	27	27	15	8,913	5,093	19,807	1,119	15,641
116	28	28	16	7,639	4,456	17,106	932	13,414
120	29	29	16	9,549	5,411	21,157	1,212	16,755
124	30	30	17	9,868	5,730	22,058	1,212	17,324
128	31	31	18	10,186	6,048	22,958	1,212	17,894
132	32	32	19	10,504	6,366	23,858	1,212	18,465
136	33	33	19	10,823	6,366	24,309	1,305	19,007
140	34	34	20	11,141	6,685	25,209	1,305	19,578
144	35	35	20	11,459	6,685	25,659	1,398	20,121
148	36	36	21	11,777	7,003	26,559	1,398	20,691
152	37	37	21	12,096	7,003	27,009	1,492	21,234
156	38	38	22	12,414	7,321	27,910	1,492	21,804
160	39	39	22	12,732	7,321	28,360	1,585	22,348
164	40	40	23	13,051	7,639	29,260	1,585	22,918
168	41	41	24	13,369	7,958	30,161	1,585	23,488
172	42	42	25	13,687	8,276	31,061	1,585	24,058
176	43	43	25	14,006	8,276	31,511	1,678	24,601
180	44	44	26	14,324	8,594	32,411	1,678	25,171
184	45	45	26	14,642	8,594	32,862	1,771	25,714
188	46	46	27	14,961	8,913	33,762	1,771	26,284
192	47	47	27	15,279	8,913	34,212	1,865	26,828

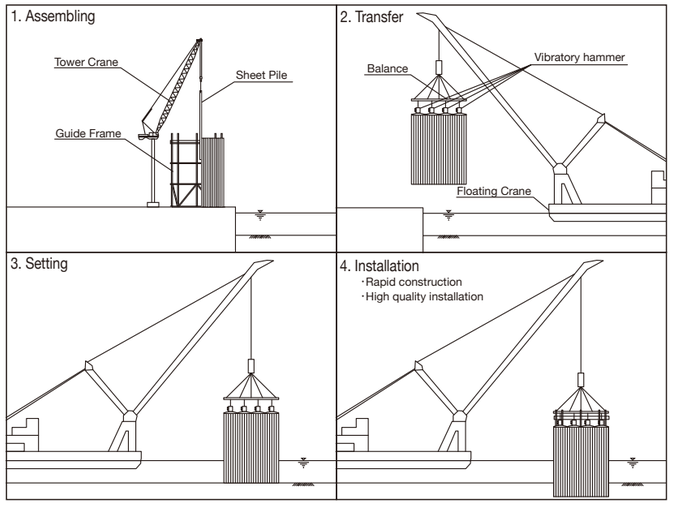




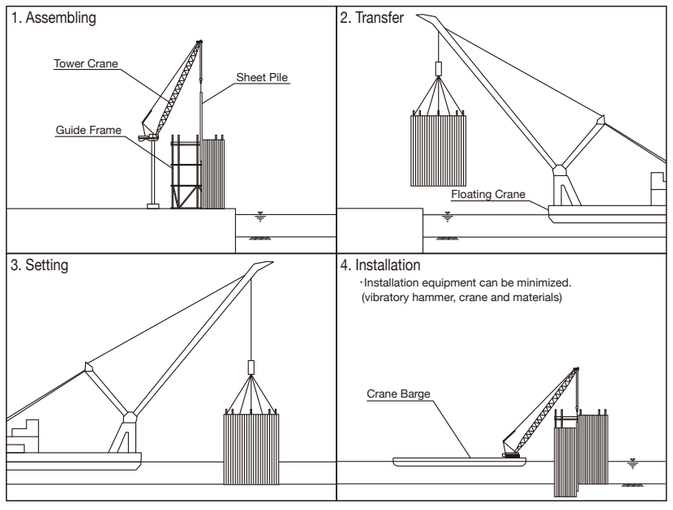
N (pcs)	N1 (pcs)	N2 (pcs)	N_A (pcs)	R (mm)	r (mm)	L (mm)	θ (deg)	β (deg)	φ (deg)	Δ (mm)	W (mm)
96	31	15	21	7,639	3,707	20,618	30.0	35	170.0	435	12,979
100	33	15	23	7,958	4,102	22,104	28.8	35	167.6	465	13,432
104	33	17	23	8,276	3,990	22,127	31.2	35	172.3	272	14,248
108	35	17	25	8,594	4,381	23,615	30.0	35	170.0	298	14,707
112	37	17	27	8,913	4,779	25,105	28.9	35	167.9	328	15,162
116	37	19	27	9,231	4,662	25,120	31.0	35	172.1	133	15,982
120	39	19	27	9,549	4,718	25,941	30.0	35	170.0	467	16,265
124	39	21	27	9,868	4,613	25,962	31.9	35	173.9	281	17,074
128	41	21	29	10,186	5,000	27,449	30.9	35	171.9	303	17,536
132	43	21	29	10,504	5,056	28,266	30.0	35	170.0	637	17,825
136	45	21	31	10,823	5,449	29,750	29.1	35	168.2	666	18,279
140	45	23	31	11,141	5,339	29,777	30.9	35	171.7	474	19,094
144	47	23	33	11,459	5,730	31,263	30.0	35	170.0	499	19,552
148	49	23	35	11,777	6,125	32,751	29.2	35	168.4	529	20,007
152	49	25	35	12,096	6,011	32,771	30.8	35	171.6	335	20,824
156	51	25	37	12,414	6,404	34,260	30.0	35	170.0	362	21,283
160	51	27	37	12,732	6,293	34,274	31.5	35	173.0	171	22,097
164	53	27	37	13,051	6,349	35,099	30.7	35	171.5	505	22,381
168	55	27	39	13,369	6,741	36,586	30.0	35	170.0	531	22,839
172	57	27	41	13,687	7,136	38,074	29.3	35	168.6	561	23,295
176	57	29	41	14,006	7,021	38,093	30.7	35	171.4	366	24,113
180	59	29	43	14,324	7,415	39,583	30.0	35	170.0	393	24,571
184	61	29	45	14,642	7,812	41,074	29.3	35	168.7	424	25,027
188	61	31	45	14,961	7,694	41,088	30.6	35	171.3	228	25,847

Construction method

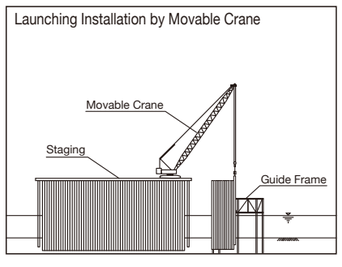
Prefabrication method

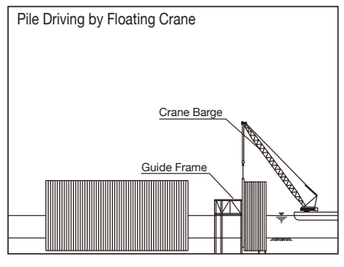


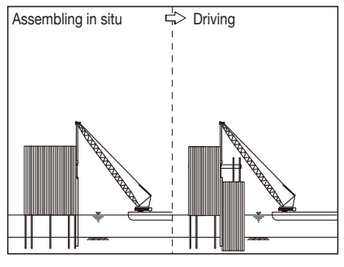
Semi-prefabrication method



In-situ method







Performance of repeated-use

Cases of performance evaluation for the repeated use of Hat-type steel sheet piles

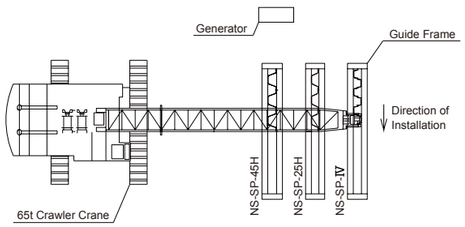
We have conducted performance evaluation for the repeated use of Hat-type steel sheet piles based on the field tests. So far, we have conducted these tests for the cases of different installation methods such as vibratory hammer methods and press-in methods.

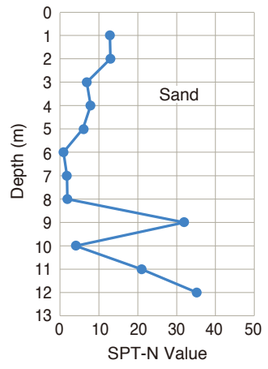
Case example of a repeated use test using a vibratory hammer

Case example of a repeated use test using a press-in machine

Piling test in Japan **Hat-type** **U-type**

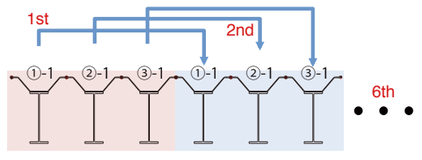
Installing and pulling out was repeated for ten times.



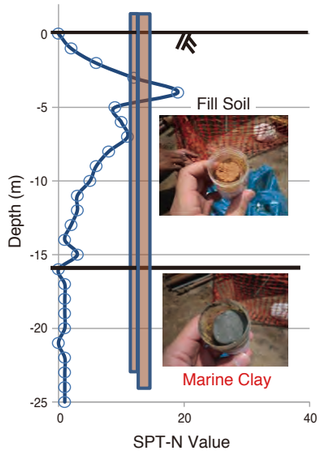


Piling test in Singapore **Hat+H**

Installing and pulling out was repeated for six times.



After 6 times Installation



Driving method

Vibration method

Sheet piles are driven into the ground by transferring to them up-and-down vibratory forces generated by a vibratory hammer. As percussion force is not used, the pile head is not damaged, driving efficiency is high, and it is useful for both driving and pulling piles.


Driving of a Hat+H sheet pile


Driving of a Hat-type sheet pile

Percussion method

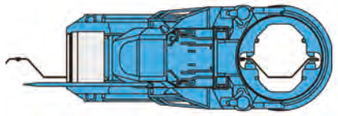
A percussion method is a method in which steel sheet piles are driven into the ground with the percussion force of a hydraulic hammer or diesel hammer. To prevent buckling at the head of the sheet pile, a pile cap is generally attached to the head of the sheet pile. Sheet piles can be easily driven with high percussion force at a location with large joint resistance or ground resistance.

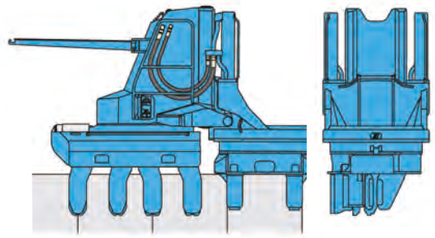

Driving of a Hat+H sheet pile

Press-in method

Sheet piles are pressed-in using hydraulic mechanism by grasping the middle place of sheet pile while taking reaction by holding driven piles. Driving machine is compact, and need no crane, though it needs crane separately for hanging sheet piles. It is applicable to the driving conditions such as narrow places and low clearance places. It is also possible to drive piles in conditions of low noise and low vibration. When ground is so hard that driving is difficult by using only pressing machine, it is useful to use water jet cutter together.

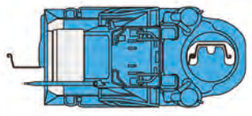
Press-in machine for Hat-type sheet pile

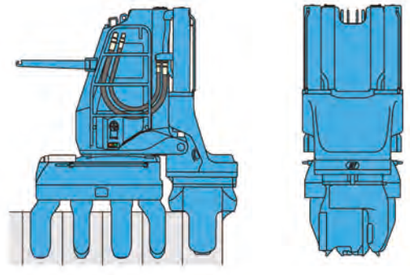

Plain view


Side view


Pressing-in of Hat-type sheet pile

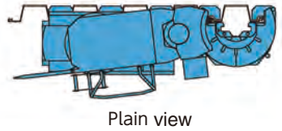
Press-in machine for U-type sheet pile

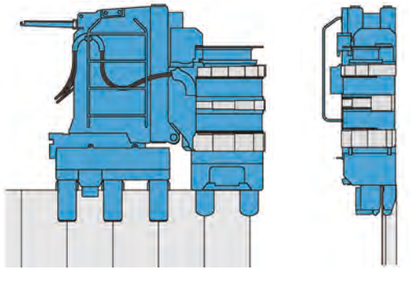

Plain view


Side view


Pressing-in of U-type sheet pile

Press-in machine for NS-SP-J (close-proximity installation)


Plain view


Side view

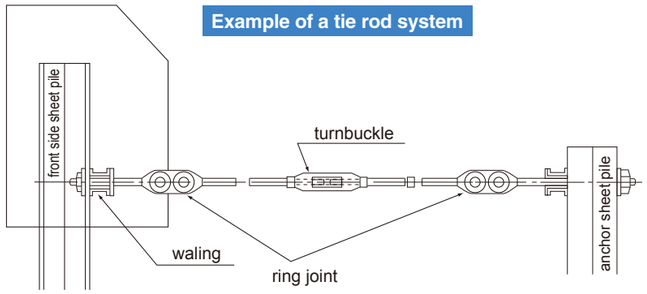

Pressing-in of NS-SP-J

Detail of tie-rods, wailing, guide frame and coping

Tie-rods and waling

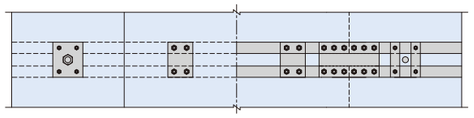
To support a part of the external force applied to the steel sheet pile, sheet pile walls are often provided with waling, tie rods, and tie wires at the upper part of the steel sheet pile. The following figures show an installation example of a tie rod and waling.

Example of a tie rod system

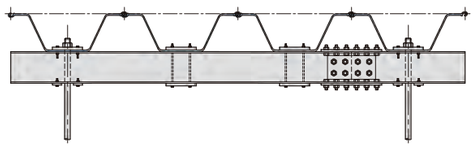


Hat-type

elevation view

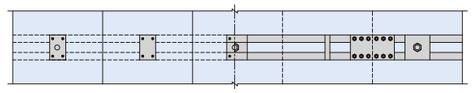


plain view



Setting waling on back face of the sheet pile

elevation view

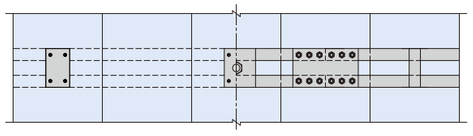


plain view

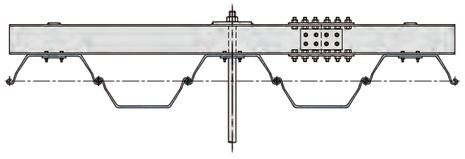
Setting waling on front face of the sheet pile

U-type

elevation view

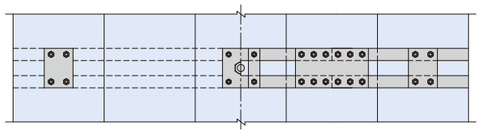


plain view

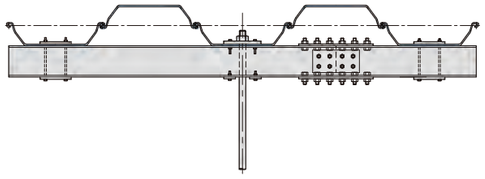


Setting waling on front face of the sheet pile

elevation view

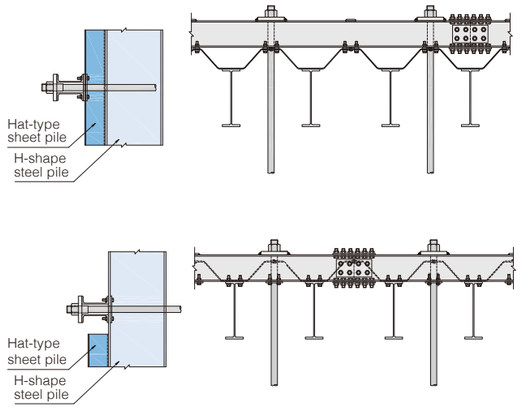


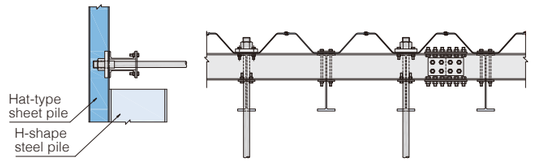
plain view



Setting waling on back face of the sheet pile

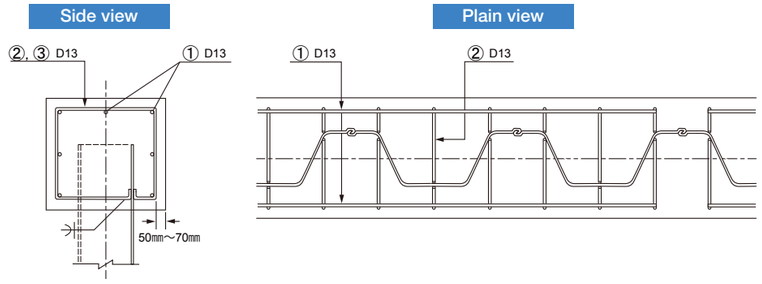
Hat+H





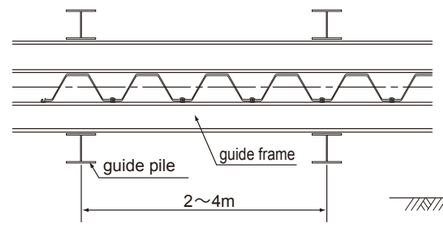
Concrete coping

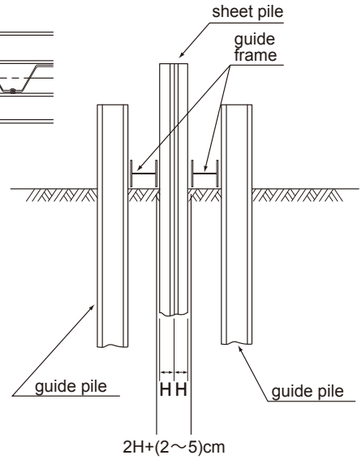
To prevent water from entering the joint or to improve joint efficiency of U-type steel sheet pile, it is usually install the concrete coping at the top of steel sheet pile walls. Here, one example shown in below.



Guide frames

In installation of steel sheet piles, it is necessary to install guide frames to ensure correct driving position and the stability of the steel sheet piles during construction. Here, one example is shown in which two rows of guide frames parallel to the normal line are driven at intervals of 2 to 4 m and in which the guide beam is mounted inside.



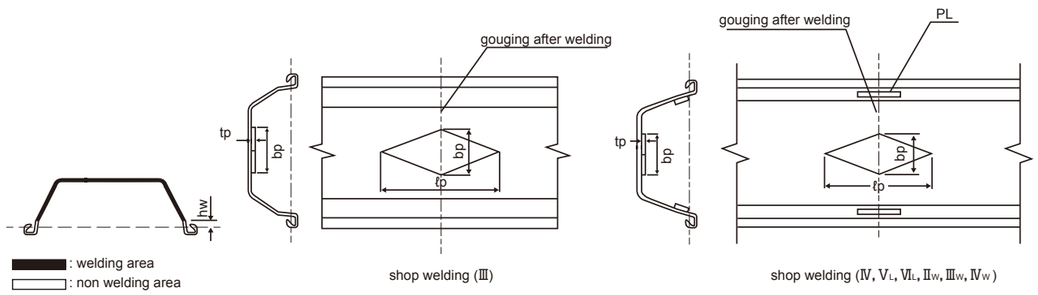


Joint

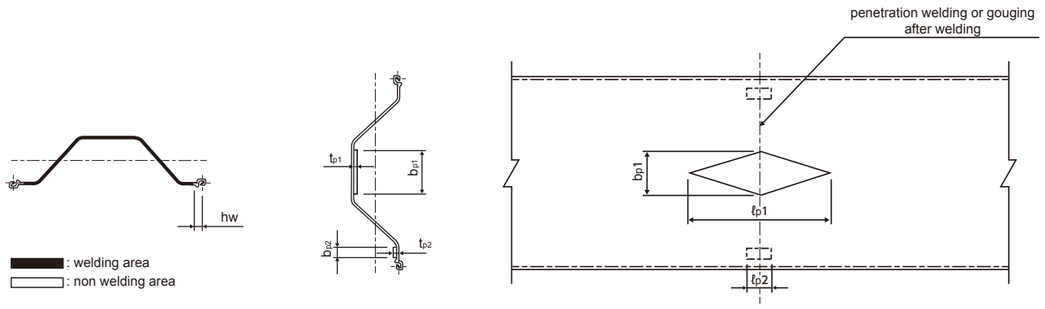
When steel sheet piles are used, multiple sheet piles are sometimes joined to obtain a specified length.
In general, a weld joint is used.

Weld joint (temporary / permanent installation)

(a) U-type sheet pile



(b) Hat-type sheet pile



When welding, it's need to choice welding rod as considering base material, thickness of sheet pile, position of weld. Here, shows the examples of welding material of JIS.

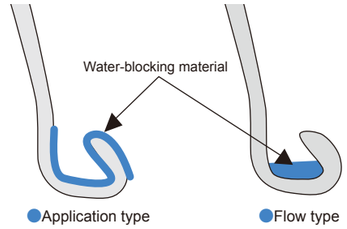
Steel sheet pile material	Hand welding		Non-gas shielded arc welding	
	Spec	Grade	Spec	Grade
SY295 SYW295	Low-hydrogen type coated electrode for grade 490N/mm²	JIS Z3212 D5016	Non-gas flux cored wire electrode for grade 490N/mm²	JIS Z3313 YFW-S50DX
SY390 SYW390	Low-hydrogen type coated electrode for grade 570N/mm²	JIS Z3212 D5816	—	—

Steel sheet pile material	CO_2 gas shielded arc welding			
	Spec	Grade	Spec	Grade
SY295 SYW295	Solid wire electrode for grade 490N/mm²	JIS Z3312 YGW11	Flux cored wire electrode for grade 490N/mm²	JIS Z3313 YFW-C50DX
SY390 SYW390	Solid wire electrode for grade 570N/mm²	JIS Z3312 YGW12	Flux cored wire electrode for grade 570N/mm²	JIS Z3313 YFW-C60FX

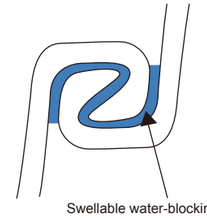
Water tightness

A steel sheet pile consists of continuous steel material and is itself water-impermeable material. However, considering the ease of driving, a slight gap is provided at the joint.
It is known that, generally, the amount of water leaking from the joint is reduced over time by clogging sand.
However, if you would like to stop water at an early stage, it is necessary to take measures to stop water at the joint.
The most popular method is when swelling water-stop material is preliminary applied to the joint. Various water-stop materials have been developed for this. For details, please contact us.

Application example water-blocking material

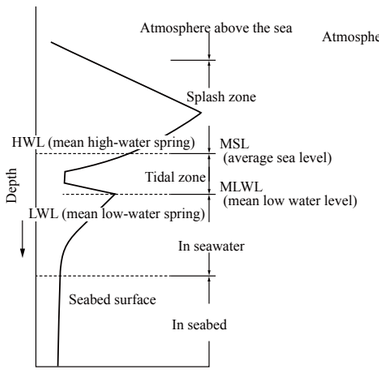


Fitting example of applied water-blocking material

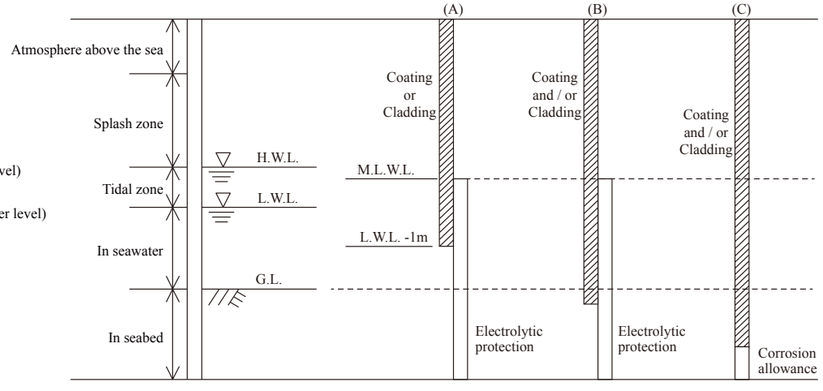


Anticorrosion system

The following methods are available to prevent the corrosion of steel sheet piles.
(1) Designing the sheet pile considering corrosion allowance
(2) Cladding using concrete to prevent corrosion
(3) Coating the sheet pile to prevent corrosion
Four types are available with regard to this method: by painting; using organic lining: using petrolatum lining; or using inorganic lining.
(4) Electrolytic protection method
Two types are available with regard to this method: by externally supplying a protection power source to prevent corrosion (external power method) or by attaching alloy such as aluminum and magnesium to the steel material as a sacrificial anode (galvanic anode method).
It is necessary to select the most-optimum corrosion prevention method according to the design and site condition. For details, please contact us.



Corrosion condition at the sea area



Example of the corrosion classification of port structures and the applied corrosion protection method