



NIPPON STEEL'S STEEL SHEET PILES

Nippon Steel Corporation

STEEL SHEET



Foreword

The steel sheet piles of Nippon Steel are used in many fields (port and harbor structures, river revetment, earth retention and cofferdams) and have acquired high market acceptance due to their excellent product quality and to construction efficiencies that derive from their use.

Nippon Steel, drawing on a wealth of rolling, fabrication and application and further adding to the superb properties of its sheet pile, has recently developed various new products and construction methods in this field, 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 two versions (NSP-10H and NSP-25H) of a new line of sheet piles: "hat-type steel sheet piles 900."

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.

PILES

(NOTE)

“NSP” “FSP” and “YSP” used in this brochure are Nippon Steel’s internal product codes for steel sheet pile products.

Features

A Wide Selection of Shapes and Types

Sheet pile is available in a wide range of selection moduli per meter of pile wall width, ranging from 874 to 8750 cm³. This allows selection of the most economical type of sheet pile to suit the design requirements and the intended construction method.

Superb Drivability and Water tightness

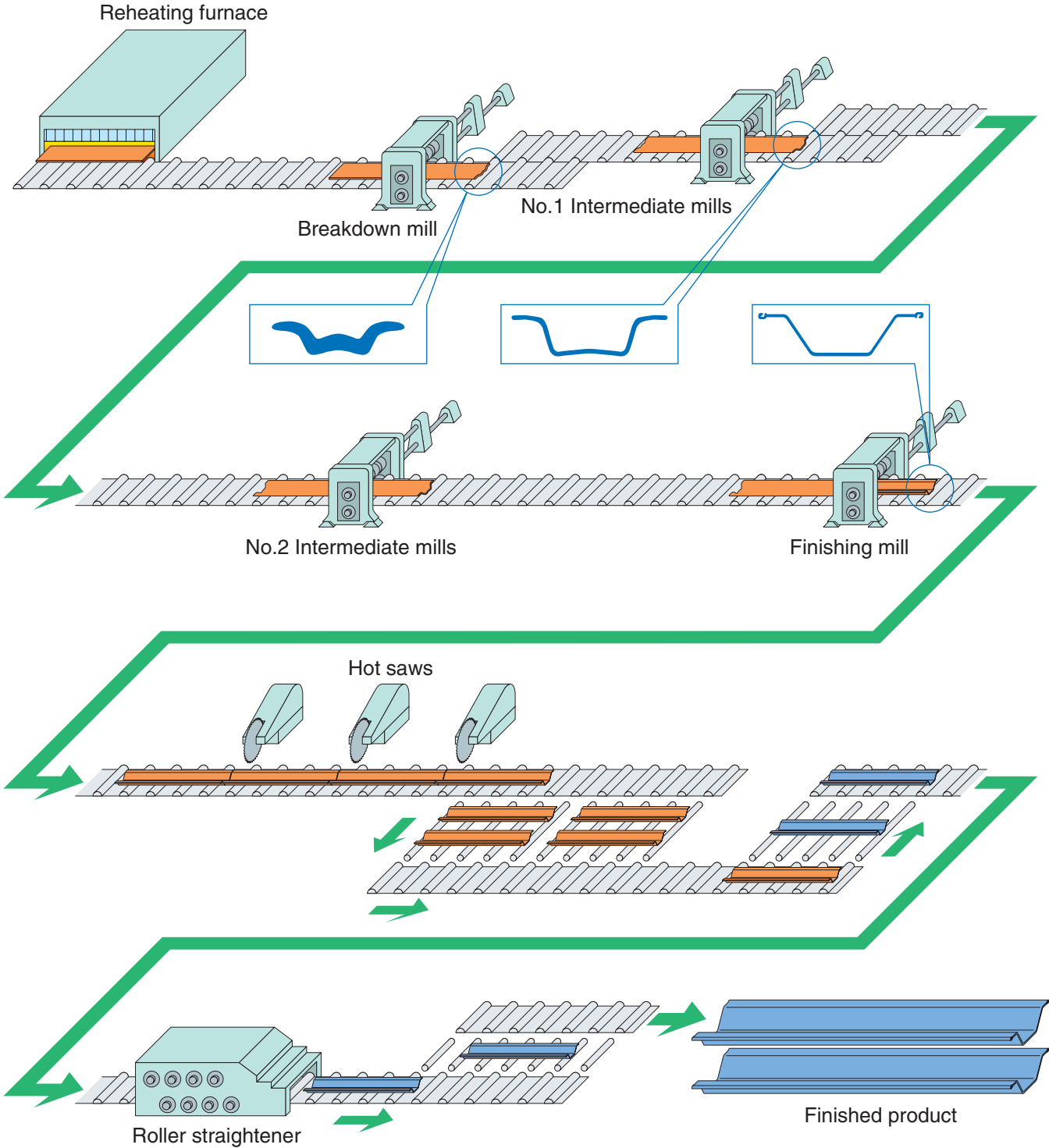
Clearances of joints are tight enough to ensure excellent drivability as well as water tightness of sheet pile wall.

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Production Process



Products

Hat-type sheet pile 900 (New)

- **Superb Drivability**

Large sectional area of the hat type sheet pile realizes superior drivability.

- **High Structural Reliability**

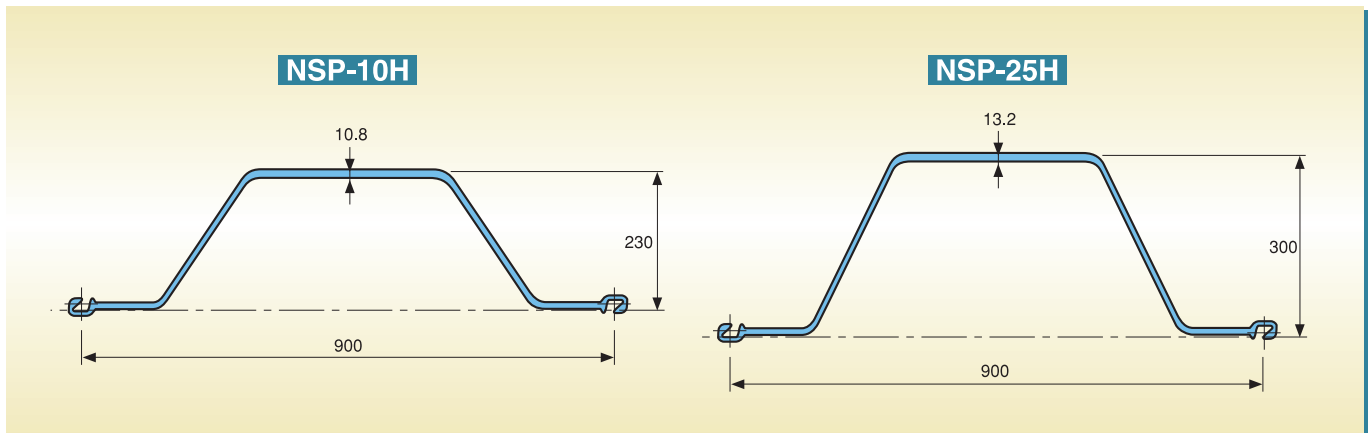
No reductions are required in sectional performance to account for possible lack of shear force transmission such as is true for conventional type of steel sheet piles.

- **Excellent Cost-effectiveness**

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



Shapes



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 cm ²	Moment of inertia cm ⁴	Section modulus cm ³	Unit mass kg/m	Sectional area cm ² /m	Moment of inertia cm ⁴ /m	Section modulus cm ³ /m	Unit mass kg/m ²
NSP-10H	900	230	10.8	110.0	9,430	812	86.4	122.2	10,500	902	96.0
NSP-25H	900	300	13.2	144.4	22,000	1,450	113	160.4	24,400	1,610	126

Hat-type sheet pile 900 (New)

Material Quality

Classification	Grade	Chemical composition						Ceq.(%)
		C	Si	Mn	P	S	Free N	Ceq.
Weldable hot rolled steel sheet pile JIS A 5523	SYW295	0.18 max.	0.55 max.	1.50 max.	0.04 max.	0.04 max.	0.0060 max.	0.44 max.
	SYW390	0.18 max.	0.55 max.	1.50 max.	0.04 max.	0.04 max.	0.0060 max.	0.46 max.

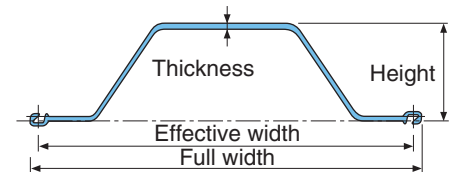
Note: $Ceq. = C + Mn/6 + Si/24 + Ni/40 + Cr/5 + Mo/4 + V/14$

Classification	Grade	Mechanical Properties			
		Yield point N/mm ²	Tensile Strength kg/m	Elongation %	Charpy V-notch toughness J
Weldable hot rolled steel sheet pile JIS A 5523	SYW295	295 min.	490 min.	17 min.	43 min.
	SYW390	390 min.	540 min.	15 min.	43 min.

Note: Chemical composition and mechanical properties conform to JIS A 5523-2006.
N is shown by total in accordance with section 5. Note 2 of JIS A 5523-2006.
Grade of S 355GP (EN 10248 Part 1) is also available upon request.
Grade SYW390 requires consultation prior to order.

Tolerance of Shapes and Dimensions

Item		Tolerance
Full width		+10mm -5mm
Height		±4%
Thickness	Under 10 mm	±1.0mm
	10 mm and over to 16 mm excl.	±1.2mm
	16 mm and over	±1.5mm
Length		+ Not specified 0
Deflection	10 m and under in length	Full length (m) × 0.12% max.
	Over 10 m in length	(Full length - 10m) × 0.10% + 12mm max.
Camber	10 m and under in length	Full length (m) × 0.25% max.
	Over 10 m in length	(Full length - 10m) × 0.20% + 25mm max.
Difference in vertically cut section		Within 4% of width



Note: 1. Tolerances of shapes and dimensions of Nippon Steel sheet piles are based on the "Standard Specifications for Steel Sheet piles" prepared by the Committee on Technological Research on Sheet Piles. They are aimed at securing improved construction efficiency and specified product quality and dimensional accuracy by users. (Tolerances shown above satisfy JIS A5523-2006 and offer additionally specified items.)

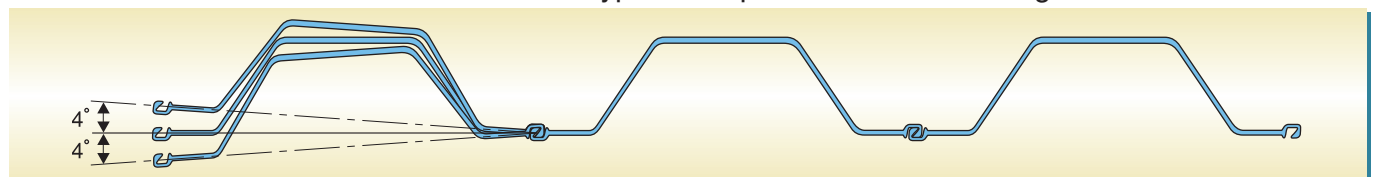
2. "Deflection" stands for the deviation from the plain parallel to the sheet pile wall, and "Camber" stands for the deviation from the plain for vertical to the sheet pile wall.

Compatibility

Interlocks of 10H version and 25H version are compatible.

Deviation Angle

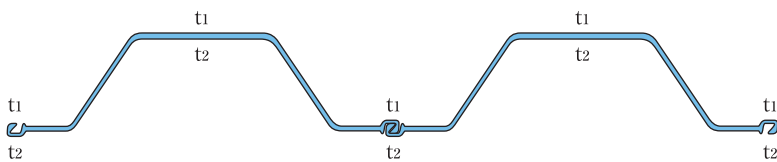
Each interlock allows a certain rotation. The maximum angle of deviation (the interlock swing) for the combination of the identical versions of hat-type sheet piles is shown in the figure below.



Sectional Properties after Corrosion

Sectional properties of hat-type sheet pile after 1 mm corrosion loss per side, totaling 2 mm in both sides, are shown in the table below.

Type	Sectional Properties without corrosion loss		Sectional Properties with 1 mm corrosion loss per side		
	I_0 (cm ⁴ /m)	Z_0 (cm ³ /m)	η (%)	I (cm ⁴ /m)	Z (cm ³ /m)
NSP-10H	10,500	902	79	8,300	713
NSP-25H	24,400	1,610	82	20,000	1,320



I_0, Z_0 : Moment inertia and section modulus without corrosion loss

η : Reduction ratio after corrosion

I, Z : Moment inertia and section modulus after corrosion

Graphs for obtaining the reduction ratio of sectional properties, η

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

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

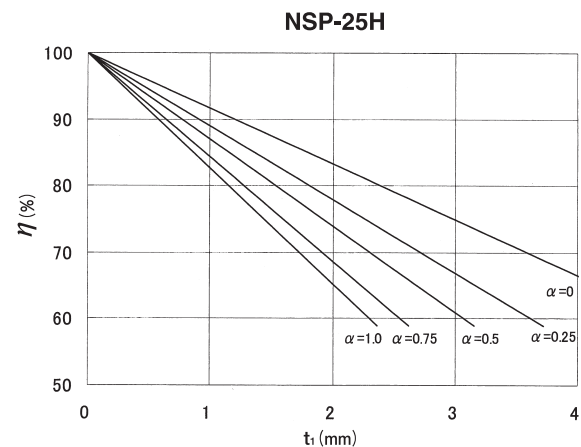
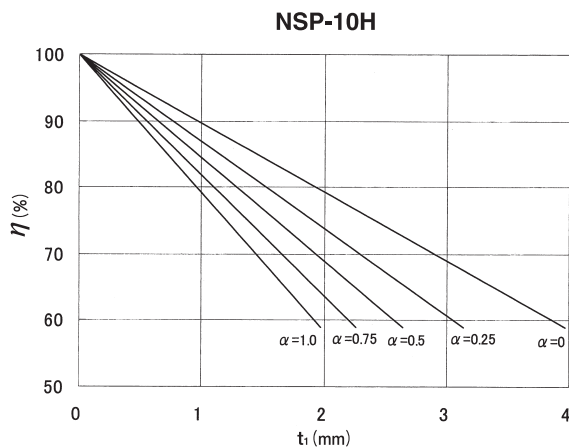
α : corrosion loss rate, $\alpha = t_2 / t_1$

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

Steps to calculate sectional properties after corrosion;

- ① Assume corrosion rate and life time of facility, and calculate the corrosion loss of marine side t_1 (mm) and that of land side t_2 (mm).
- ② Calculate corrosion loss rate $\alpha (=t_2 / t_1)$.
- ③ By using the corrosion loss of marine side, t_1 (mm) and the corrosion loss rate α , obtain the reduction ratio of 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, Z_0 and I_0 by the reduction ratio η

Section modulus $Z = Z_0 \times \eta$ Moment inertia $I = I_0 \times \eta$



Products

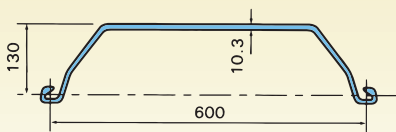
U type sheet pile

- U type sections have been widely used for various types of permanent and temporary structures, and one of the most familiar sheet piles among designers as well as users.
- FSP- II , III, IV, V_L and VI_L are solidly designed. These sections are especially suitable for repeated use, and have acquired high market acceptance from users.
- U type sections offer section modulus ranging from 874 cm³ to 3820 cm³ per linear meter of wall.

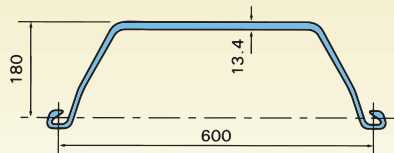


Shapes

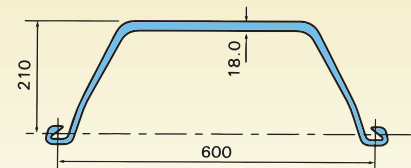
NSP-II_w



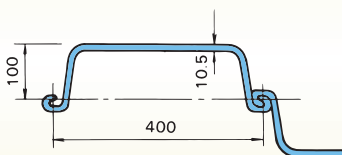
NSP-III_w



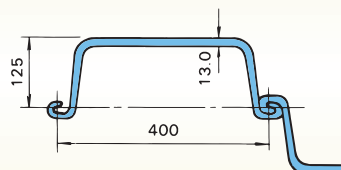
NSP-IV_w



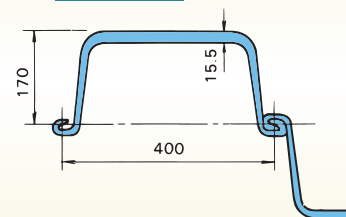
FSP-II



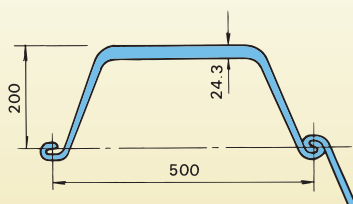
FSP-III



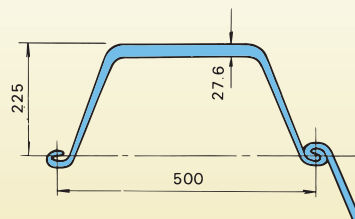
FSP-IV



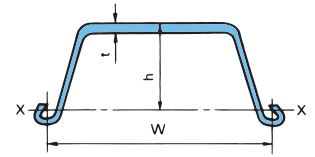
FSP-V_L



FSP-VI_L



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 cm ²	Moment of inertia cm ⁴	Section modulus cm ³	Unit mass kg/m	Sectional area cm ² /m	Moment of inertia cm ⁴ /m	Section modulus cm ³ /m	Unit mass kg/m ²
FSP-II	400	100	10.5	61.18	1,240	152	48.0	153.0	8,740	874	120
FSP-III	400	125	13.0	76.42	2,220	223	60.0	191.0	16,800	1,340	150
FSP-IV	400	170	15.5	96.99	4,670	362	76.1	242.5	38,600	2,270	190
FSP-V _L	500	200	24.3	133.8	7,960	520	105	267.6	63,000	3,150	210
FSP-VI _L	500	225	27.6	153.0	11,400	680	120	306.0	86,000	3,820	240
NSP-II _w	600	130	10.3	78.70	2,110	203	61.8	131.2	13,000	1,000	103
NSP-III _w	600	180	13.4	103.9	5,220	376	81.6	173.2	32,400	1,800	136
NSP-IV _w	600	210	18.0	135.3	8,630	539	106	225.5	56,700	2,700	177

Material Quality

Classification	Grade	Chemical composition (%)						Req. (%)
		C	Si	Mn	P	S	N	Req.
Weldable hot rolled steel sheet piles JIS A 5523	SYW295	0.18 max.	0.55 max.	1.50 max.	0.04 max.	0.04 max.	0.0060 max.	0.44 max.
	SYW390	0.18 max.	0.55 max.	1.50 max.	0.04 max.	0.04 max.	0.0060 max.	0.46 max.
Hot rolled steel sheet piles JIS A 5528	SY295	—	—	—	0.04 max.	0.04 max.	—	—
	SY390	—	—	—	0.04 max.	0.04 max.	—	—

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

Classification	Grade	Mechanical Properties			
		Yield point (N/mm ²)	Tensile strength (N/mm ²)	Elongation (%)	Charpy V-notch toughness [0C°] (J)
Weldable hot rolled steel sheet piles JIS A 5523	SYW295	295 min.	490 min.	17 min.	43 min.
	SYW390	390 min.	540 min.	15 min.	43 min.
Hot rolled steel sheet piles JIS A 5528	SY295	295 min.	490 min.	17 min.	—
	SY390	390 min.	540 min.	15 min.	—

Note: Chemical composition and mechanical properties conform to JIS A 5523-2006 or JIS A 5528-2006 .
N is shown by total in accordance with section 5. Note 2 of JIS A 5523-2006.
Grade of S 355GP (EN 10248 Part 1) is also available upon request.

Products

U type sheet pile

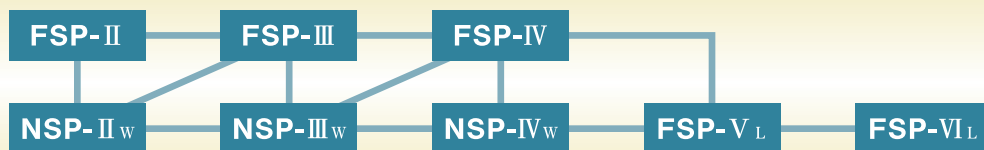
Tolerance of Shapes and Dimensions

Item		Tolerance	(Reference) Tolerance in JIS
Total width		Effective width $\times \pm 1\%$ (+6mm and -5mm for II _w , III _w and IV _w)	+10mm - 5mm
Total Height		$\pm 4\%$	$\pm 4\%$
Thickness	Under 10 mm	+1.0mm -0.3mm	$\pm 1.0\text{mm}$
	10 mm and over to 16 mm excl.	+1.2mm -0.3mm	$\pm 1.2\text{mm}$
	16 mm and over	+1.5mm -0.3mm	$\pm 1.5\text{mm}$
Length		+ Not specified 0	+ Not specified 0
Deflection	10 m and under in length	Full length $\times 0.1\%$ max. 20mm max.	Full length $\times 0.12\%$ max.
	Over 10 m in length		(Full length - 10m) $\times 0.10\%$ +12mm max.
Camber	10 m and under in length	Full length $\times 0.2\%$ max. 20mm max.	Full length $\times 0.25\%$ max.
	Over 10 m in length		(Full length - 10m) $\times 0.20\%$ +25mm max.
Difference in vertically cut section		Within 4% of width	Within 4% of width
Difference in total width		4mm and under in difference between maximum and minimum total widths within 1m length from the edge	Not specified
Edge deflection		The values measured at the topside 1m from the edge and up to 1.5mm, or 1/2 the values measured at the tangent side and up to 1.5mm	Not specified

Note: 1. Tolerances of shapes and dimensions of Nippon Steel sheet piles are based on the "Standard Specifications for Steel Sheet piles" prepared by the Committee on Technological Research on Sheet Piles. They are aimed at securing improved construction efficiency and specified product quality and dimensional accuracy by the users. (The tolerances shown above satisfy JIS A5523-2006 or JIS A5528-2006 and offer additionally specified items.)

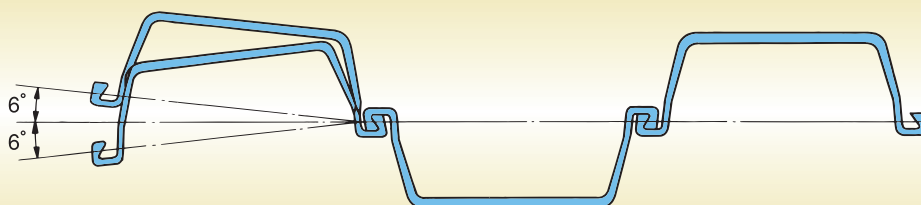
2. "Deflection" stands for the deviation from the plain parallel to the sheet pile wall, and "Camber" stands for the deviation from the plain for vertical to the sheet pile wall.

Compatibility



Deviation Angle

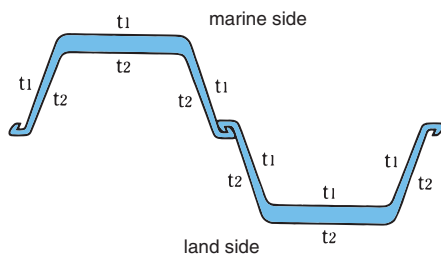
Each interlock allows a certain rotation. The maximum angle of deviation (the interlock swing) for the combination of the identical versions of hat-type sheet piles is shown in the figure below.



Sectional Properties after Corrosion

Sectional properties of U type sheet pile after 1 mm corrosion loss per side, totaling 2 mm in both sides, are shown in the table below.

Type	Sectional Properties without corrosion loss		Sectional Properties with 1 mm corrosion loss per side		
	I_0 (cm ⁴ /m)	Z_0 (cm ³ /m)	η (%)	I (cm ⁴ /m)	Z (cm ³ /m)
FSP-II	8,740	874	81	7,080	708
FSP-III	16,800	1,340	85	14,300	1,140
FSP-IV	38,600	2,270	86	33,200	1,950
FSP-V _L	63,000	3,150	91	57,300	2,870
FSP-VI _L	86,000	3,820	92	79,100	3,510
NSP-II _w	13,000	1,000	81	10,500	810
NSP-III _w	32,400	1,800	85	27,500	1,530
NSP-IV _w	56,700	2,700	88	49,900	2,380



I_0, Z_0 : Moment inertia and section modulus without corrosion loss

η : Reduction ratio after corrosion

I, Z : Moment inertia and section modulus after corrosion

Steps to calculate sectional properties after corrosion;

- ① Assume corrosion rate and life time of facility, and calculate the corrosion loss of marine side t_1 (mm) and that of land side t_2 (mm).
- ② Calculate corrosion loss rate α ($=t_2/t_1$).
- ③ By using the corrosion loss of marine side, t_1 (mm) and the corrosion loss rate α , obtain the reduction ratio of 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, Z_0 and I_0 by the reduction ratio η

Section modulus $Z=Z_0 \times \eta$ Moment inertia $I= I_0 \times \eta$

Products

U type sheet pile

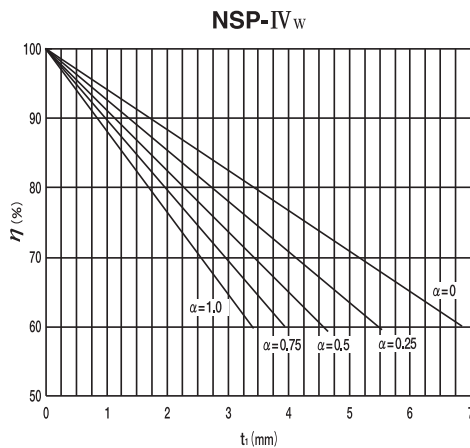
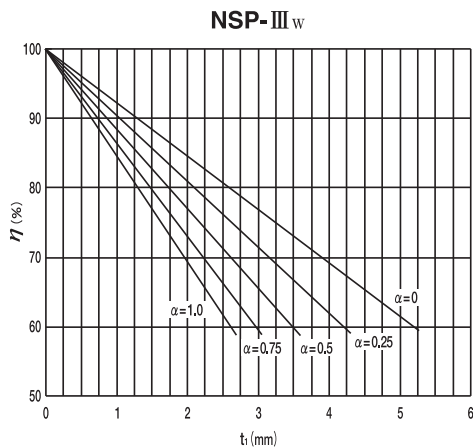
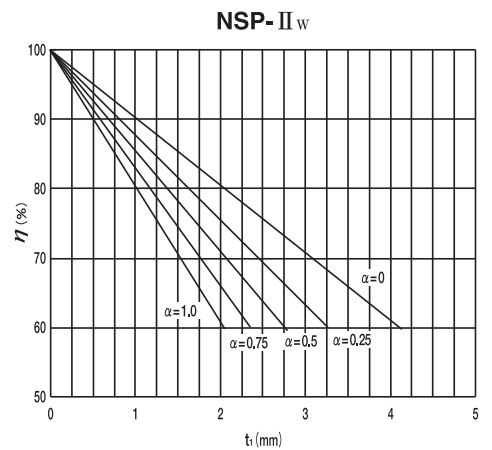
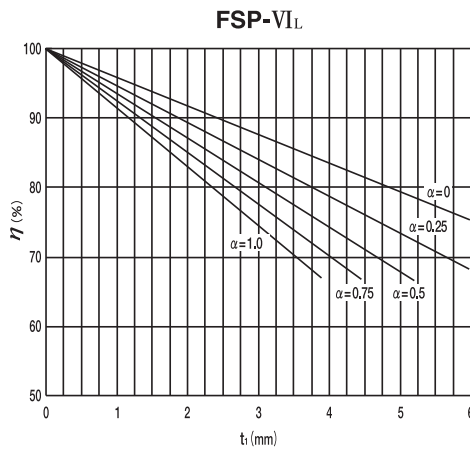
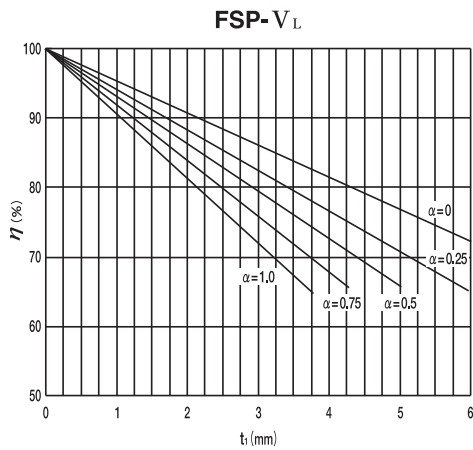
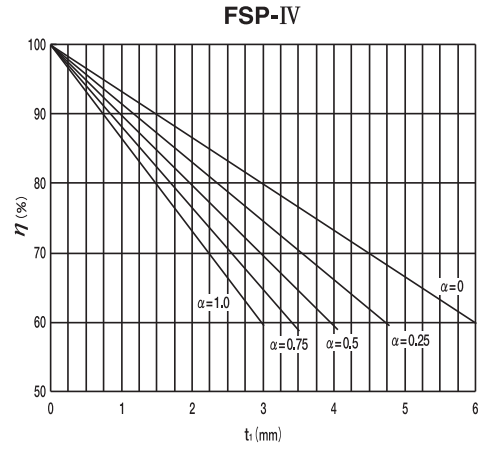
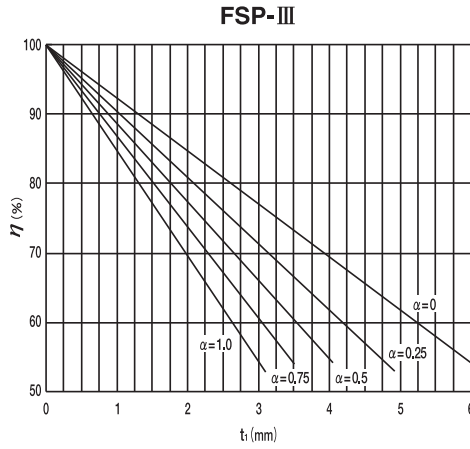
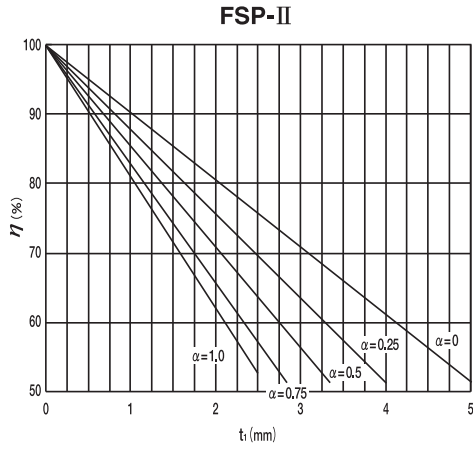
Graphs for obtaining the reduction ratio of sectional properties, η

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, $\alpha = t_2 / t_1$

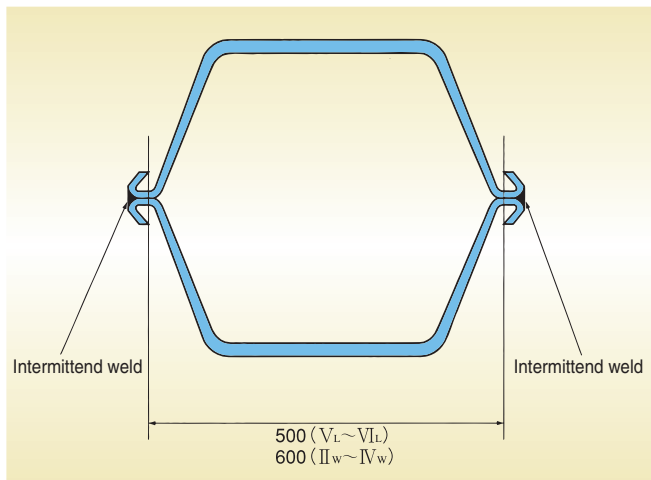
Note : Only the illustrated ranges are effective in the following graphs.



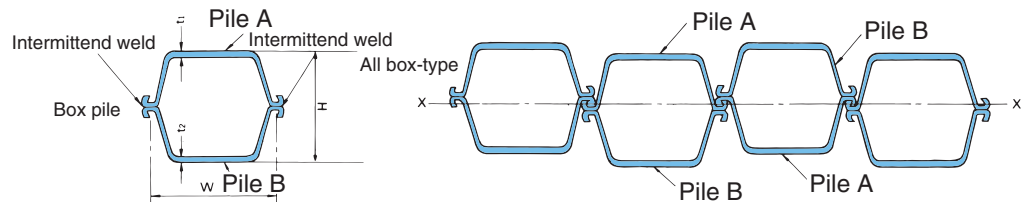
Box type sheet pile

- Box type sections are made of two U type sections welded together into a box shape. Appropriate combination of sheet piles makes available a wide range of section modulus, and depending upon design requirements, the most suitable and economical combination can be selected.
- Having section modulus ranging from 4170 cm³ to 8750 cm³ per linear meter of wall, Box type sections are suited in large quay walls.
- The length of each U type sheet pile welded together into a box section can be changed to meet design conditions, and this means great economy.

Shapes



Sectional Properties



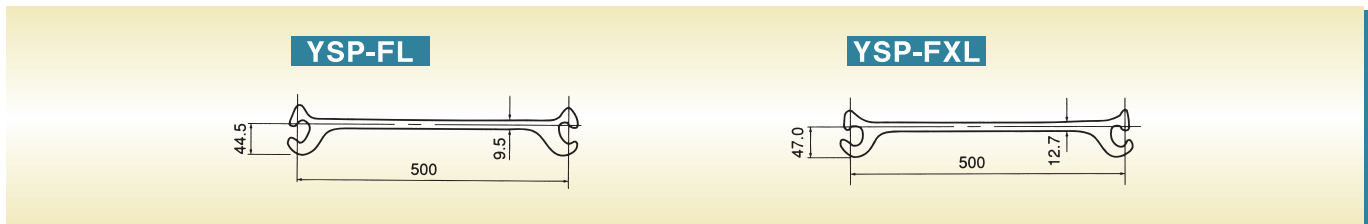
Type		Dimension				Per pile				Per 1 m of pile wall width			
		Effective width W mm	Effective height H mm	Thickness		Sectional area cm ²	Moment of inertia cm ⁴	Section modulus cm ³	Unit mass kg/m	Sectional area cm ² /m	Moment of inertia cm ⁴ /m	Section modulus cm ³ /m	Unit mass kg/m ²
t ₁ mm	t ₂ mm												
FSP-V _L	FSP-V _L	500	445	24.3	24.3	267.6	79,000	3,550	210	535.2	158,000	7,100	420
FSP-VI _L	FSP-V _L	500	471	27.6	24.3	286.8	92,900	3,870	225	573.6	186,000	7,740	450
FSP-VI _L	FSP-VI _L	500	497	27.6	27.6	306.0	109,000	4,370	240	612.0	217,000	8,750	480
NSP-III _w	NSP-III _w	600	404	13.4	13.4	207.8	50,600	2,500	163	346.3	84,300	4,170	272
NSP-IV _w	NSP-III _w	600	435	18.0	13.4	239.2	66,400	2,860	188	398.7	111,000	4,770	313
NSP-IV _w	NSP-IV _w	600	466	18.0	18.0	270.6	86,500	3,710	212	451.0	144,000	6,190	353

Products

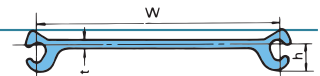
Straight Web-Type Sheet Pile

- 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 structure such as quay walls, seawalls of manmade island, cofferdams and other similar works

Shapes



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 cm ²	Moment of inertia cm ⁴	Section modulus cm ³	Unit mass kg/m	Sectional area cm ² /m	Moment of inertia cm ⁴ /m	Section modulus cm ³ /m	Unit mass kg/m ²
YSP-FL	500	44.5	9.5	78.57	184	45.7	61.7	157.1	396	89	123
YSP-FXL	500	47.0	12.7	98.36	245	60.3	77.2	196.7	570	121	154

Note: 1. Straight web –type sheet pile of SYW295 and SY295 offers joint strength of 3.92 MN/m and over for YSP-FL and 5.88 MN/m and over for YSP-FXL.
2. Straight web –type sheet piles with web thickness of 12.5, 12.0 and 11.5 mm require consultation prior to order.

Material Quality

Classification	Grade	Chemical composition (%)						Ceq.(%)
		C	Si	Mn	P	S	N	Ceq.
Weldable hot rolled steel sheet piles JIS A 5523	SYW295	0.18 max.	0.55 max.	1.50 max.	0.04 max.	0.04 max.	0.0060 max.	0.44 max.
	SYW390	0.18 max.	0.55 max.	1.50 max.	0.04 max.	0.04 max.	0.0060 max.	0.46 max.
Hot rolled steel sheet piles JIS A 5528	SY295	—	—	—	0.04 max.	0.04 max.	—	—
	SY390	—	—	—	0.04 max.	0.04 max.	—	—

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

Classification	Grade	Mechanical Properties			
		Yield point (N/mm ²)	Tensile strength(N/mm ²)	Elongation (%)	Charpy V-notch toughness[0C°] (J)
Weldable hot rolled steel sheet piles JIS A 5523	SYW295	295 min.	490 min.	17 min.	43 min.
	SYW390	390 min.	540 min.	15 min.	43 min.
Hot rolled steel sheet piles JIS A 5528	SY295	295 min.	490 min.	17 min.	—
	SY390	390 min.	540 min.	15 min.	—

Note: Chemical composition and mechanical properties conform to JIS A 5523-2006 or JIS A 5528-2006 .
: N is shown by total in accordance with section 5. Note 2 of JIS A 5523-2006.

Tolerance of Shapes and Dimensions

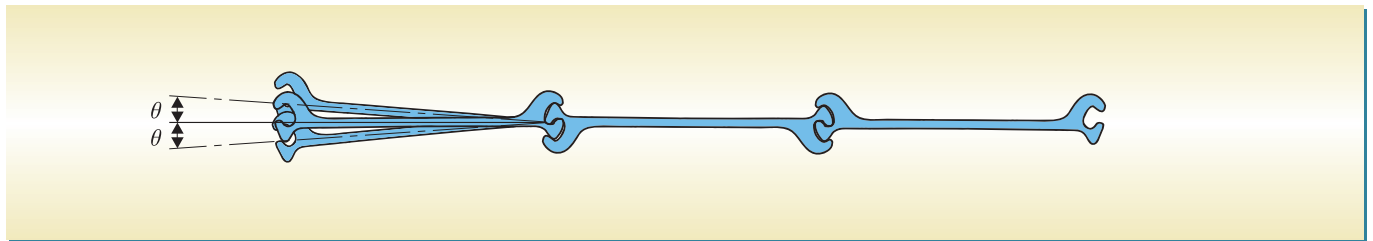
Item		Tolerance
Width		± 4 mm
Height		—
Thickness	Up to 10 mm	+1.5 mm -0.7 mm
	10 mm and over to 16 mm excl.	+1.5 mm -0.7 mm
	16 mm and over	—
Length		+ Not specified 0
Deflection	10 m and under in length	Full length (m) \times 0.15% max.
	Over 10 m in length	(Full length - 10m) \times 0.10% + 15mm max.
Camber	10 m and under in length	Full length (m) \times 0.20% max.
	Over 10 m in length	(Full length - 10m) \times 0.10% + 20mm max.
Difference in vertically cut section		Within 4% of width

Note: 1. Tolerances shown above satisfy JIS A5523-2006 and JIS A5528-2006.

2. "Deflection" stands for the deviation from the plain parallel to the sheet pile wall, and "Camber" stands for the deviation from the plain for vertical to the sheet pile wall.

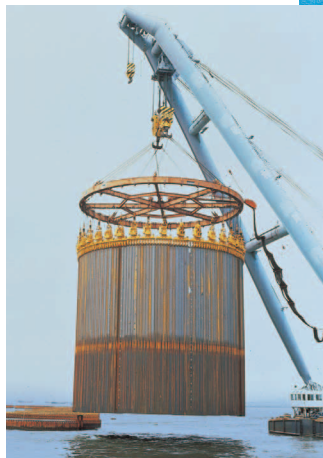
Deviation Angle

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



YSP-FL $\theta = \pm 12.5^\circ$

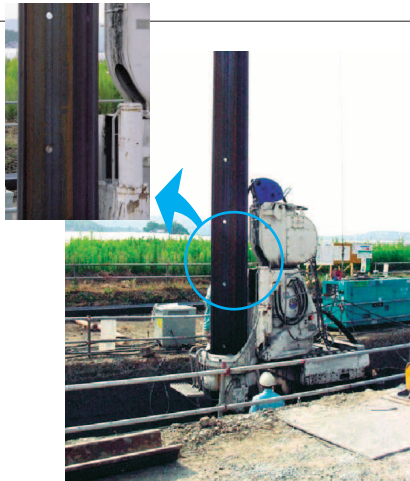
YSP-FXL $\theta = \pm 10^\circ$



(1) River embankments



Permanent use as well as temporary cofferdam use



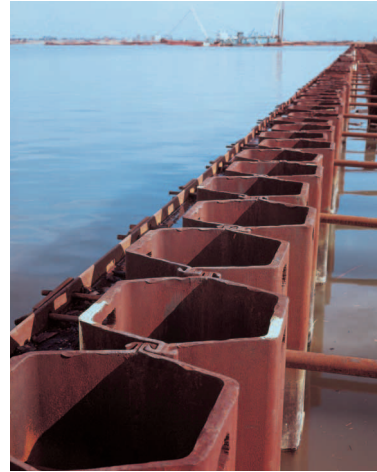
Permeable sheet pile wall with holes for subsurface water flow



Subsurface water flow stoppage wall



(2) Quay walls of port facilities



(3) Earth-retaining wall for road construction



Steel sheet pile wall is covered by concrete panels to conform to the neighboring view.

(4) Erosion and sedimentation control dam in mountain area



Driving Method

Vibration method

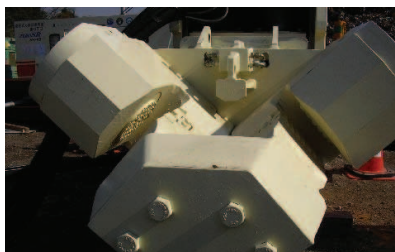
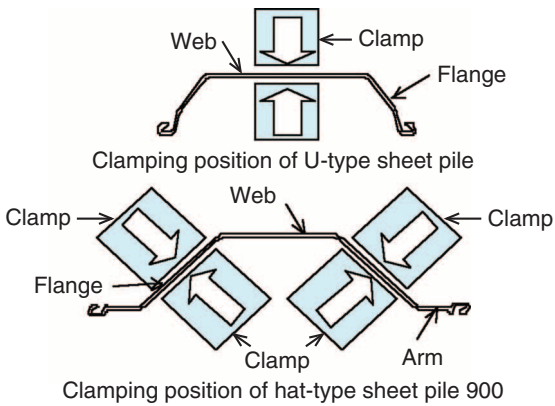
Sheet piles are driven into the ground by transferring to them up-and-down vibratory forces generated by vibratory hammer. Because percussion force is not used, pile head is not injured, driving efficiency is high and, is useful for both driving and pulling piles.



Driving of hat-type sheet pile 900



Driving of U-type sheet pile



Clamp for hat-type sheet pile 900

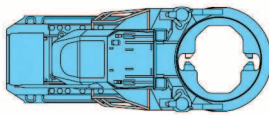


Vibratory hammer equipped with clamp for hat-type sheet pile 900

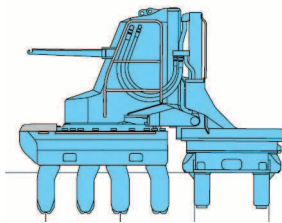
Press-in method

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 not 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 900



Over view

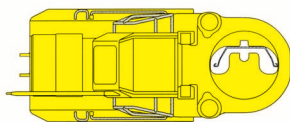


Side view

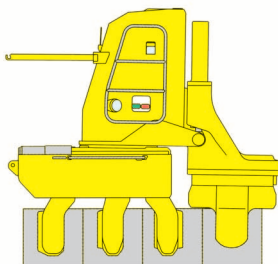


Pressing-in of hat-type sheet pile 900

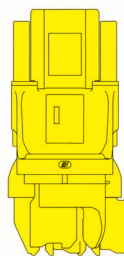
Press-in machine for U-type sheet pile



Over view



Side view



Pressing-in of U-type sheet pile

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STEEL SHEET PILES

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