

# High Stiffness Steel Element for Retaining Wall: J-domer™

## 1. Introduction

Construction projects in urban areas face constraints on construction space and duration due to existing structures and partial common use of structures. In construction of cut and cover tunnels and earth retaining walls, construction of the retaining wall body in a small space and a thin wall body are demanded. To meet this need, JFE steel developed a high stiffness steel element for earth retaining walls, “J-domer™,” using a combination of straight web sheet piles and H-shaped steel. This report presents an outline of J-domer, together with its features and examples of application.

## 2. Outline of J-domer™

### 2.1 Cross Sectional Shape and Material

J-domer, as shown in **Fig. 1**, is a steel retaining wall component in which H-shaped steel is attached to a straight web sheet pile by welding assembly. Since the two flange edges of the pile have joints, construction of a steel diaphragm wall with high water cut-off performance is possible by driving piles into the ground while fitting these joints together.

The chemical composition and mechanical properties of the straight web sheet piles and H-shaped steel materials used in J-domer follow the original standard JD490 shown in **Table 1** and **Table 2**, respectively. This JD490 standard is equivalent to SM490A provided in JIS G 3106 (Rolled steels for welded structure).

### 2.2 Size and Cross-Sectional Properties

**Table 3** shows the current main lineup of J-domer and the cross-sectional properties of each type. The new straight web sheet pile “J-FLATPILE™” manufactured by JFE Steel is used. As a result of a review of its geometry, the weight of this product was reduced by approximately 14% in comparison with the conventional type of straight web sheet pile (FL type). The standard sizes of the H-shaped steel used in combina-

tion with this sheet pile are heights of 350 to 1000 mm and widths of 200 to 350 mm.

### 2.3 Construction Methods of J-domer™

When driving J-domer into ground, the press-in method using a low noise, low vibration hydraulic pile jacking machine and the vibro hammer method, which offers excellent economy and simplicity in construction, can be applied. J-domer can also be applied as the core material of soil cement diaphragm walls, represented by the TRD method. When using the press-in method, it is possible to apply H-shaped steel sizes up to a height of 600 mm due to the clearance restriction with the chuck part of the hydraulic pile jacking machine.

## 3. Merits of J-domer™

The first merit of J-domer is its high stiffness with compact cross section. **Figure 2** shows the relation between the moment of inertia and the thickness of the

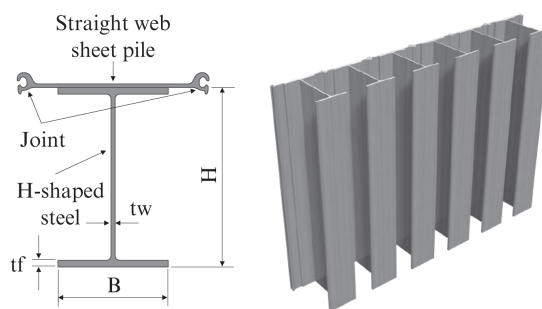


Fig. 1 Cross-sectional shape and image of steel wall

Table 1 Chemical composition of J-domer™

Composition Symbol	C	Si	Mn	P	S	Ceq
JD490	≥0.20	≥0.55	≥1.65	≥0.035	≥0.035	≥0.44

※ Ceq: Carbon equivalent =  $C + Mn/6 + Si/24 + Ni/40 + Cr/5 + Mo/4 + V/14$

Table 2 Mechanical properties of J-domer™

Symbol	Yield strength	Tensile strength	Elongation	
	N/mm <sup>2</sup>	N/mm <sup>2</sup>	Test piece	%
JD490	≥315	490~610	No.1A	17

† Originally published in *JFE GIHO* No. 43 (Feb. 2019), p. 100–102

Table 3 Product line-up and cross-sectional properties of J-domer™

Type	Dimension				Cross-sectional properties			
	$H$	$B$	$tw$	$tf$	$A$	$W$	$I$	$Z$
	(mm)	(mm)	(mm)	(mm)	(cm <sup>2</sup> /m)	(kg/m/m)	(cm <sup>4</sup> /m)	(cm <sup>3</sup> /m)
JD350SLH	350	350	12	19	478.6	375.8	111 000	4 920
JD390SLH	390	300	10	16	401.4	315.8	111 000	4 260
JD440SLH	440	300	11	18	442.6	347.8	156 000	5 440
JD488SLH	488	300	11	18	453.2	355.8	196 000	6 180
JD500SLH	500	300	16	28	615.8	483.8	280 000	9 170
JD550SLH	550	300	16	28	631.8	495.8	345 000	10 300
JD588SLH	588	300	12	20	509.2	399.8	316 000	8 480
JD600SLH	600	300	16	32	693.2	543.8	455 000	12 600
JD400SLH-S	400	200	8	13	301.5	236.6	78 400	2 690
JD450SLH-S	450	200	9	14	325.7	255.6	107 000	3 360
JD500SLH-S	500	200	10	16	359.4	282.2	148 000	4 290
JD600SLH-S	600	200	11	17	398.2	311.8	234 000	5 800
JD700SLH	700	300	13	24	597.8	469.8	525 000	12 200
JD800SLH	800	300	14	26	661.8	519.8	748 000	15 500
JD900SLH	900	300	16	28	746.4	585.8	1 030 000	19 400
JD1000SLH	1 000	300	19	36	925.0	725.8	1 560 000	27 200
JD1000SLH-L	1 000	350	19	40	1 050.0	823.8	1 840 000	32 700

$A$ : Area of cross-section of per unit width

$W$ : Mass of per unit width and length

$I$ : Moment of inertia about neutral axis per unit width and length

$Z$ : Section modulus per unit width and length

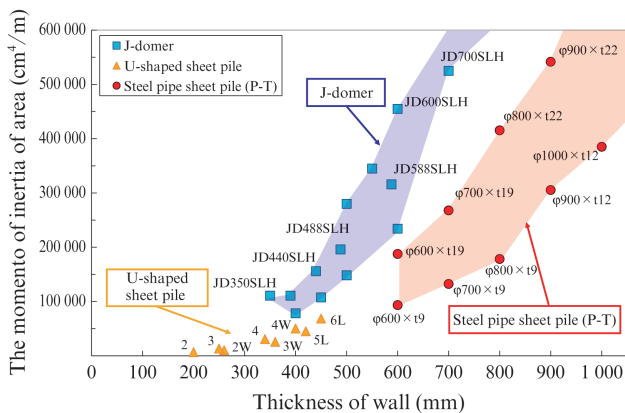


Fig. 2 Relation between the moment of inertia of the area and the thickness of wall

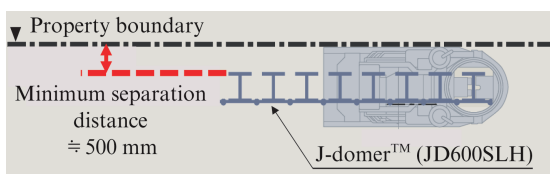


Fig. 3 Image of J-domer™ driving by the property boundary (Example of JD600SLH)

retaining wall with J-domer. In comparison with steel pipe sheet piles having the same moment of inertia, the wall thickness of J-domer can be reduced by approximately 300 mm to 500 mm. Moreover, it is also possible

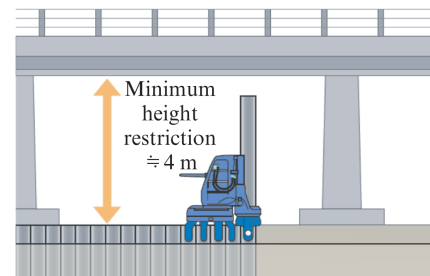


Fig. 4 Image of J-domer™ driving under the height restriction

to secure a higher section stiffness with the same wall thickness.

The second merit is the wide product lineup. Because J-domer is manufactured by welding assembly of two steel components, the size of the H-shaped steel can be selected freely, corresponding to the design of the retaining wall, provided the flange width of the H-shaped steel is up to about 350 mm.

Third, construction is possible under various construction restrictions. Since a compact hydraulic pile jacking machine can be used, it is possible to drive J-domers close to the property boundary, even in small spaces. For example, when driving JD600SLH, the minimum separation distance between the back side flange position and the property boundary can be as close as about 500 mm, as shown in in Fig. 3. Furthermore, as shown in Fig. 4, pile-driving under height

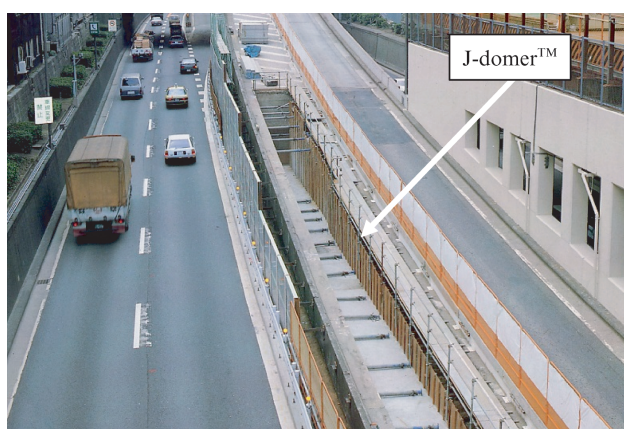


(a) Before construction



(b) After construction

Photo 1 Application example No.1



(a) Under construction



(b) After construction

Photo 2 Application example No.2

restrictions is possible if a clearance of about 4 m can be secured.

#### 4. Examples of Application

**Photo 1** is an example in which a vertical cantilever retaining wall using J-domer was constructed on a slope along residential land. In road widening construction accompanying the construction of a new right-turn lane, it was necessary to set back the retaining wall. Because the construction site adjoined private houses, J-domer was adopted in recognition of its advantages of high stiffness and a thin wall thickness. As the size of the J-domer H-shaped steel, heights of 400 mm and 488 mm and lengths of 14.0 m and 15.5 m were used, and the pile were driven by the press-in method. **Photo 2** is also an example to road widening construction. The width of the ramp on the right side of the main lanes was reduced, and number of lanes was increased from 2 to 3, and in this work, the retaining wall was moved. When carrying out construction in urban areas, it is necessary to consider the surrounding environment and make it possible for space-saving con-

struction in order to keep traffic disruptions to the absolute minimum. J-domer was selected, as it can meet these requirements. In this case, the H-shaped steel sizes were a height of 400 mm and lengths of 3.5 to 9.5 m. Driving was performed by the press-in method in combination with water jetting.

#### 5. Conclusion

This report presented an outline of the high stiffness steel element for retaining walls “J-domer”, together with its features and examples of application. In the future, we hope that the features of this product will contribute to the construction of economical earth retaining walls.

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[http://www.jfe-steel.co.jp/products/construction/sheet\\_pile/j\\_domeru.html](http://www.jfe-steel.co.jp/products/construction/sheet_pile/j_domeru.html)

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