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Construction Products and Application Methods Using JFESP-FLJ™

1. Introduction

Straight-shaped steel sheet piles, which are a type of steel sheet pile with the feature of high joint tensile strength, are manufactured by hot rolling in the same way as general sheet piles, and are mainly used as steel shell materials in "cell structures," which are arc- or cylindrical-shaped wall structures. For improved economy, JFE Steel improved the joint shape of its conventional FL type straight-shaped steel sheet pile without changing its effective width (W500 mm) and web thickness (t9.5 mm), and developed the new straight-shaped steel sheet pile "JFESP-FLJ™," in which the steel weight was reduced by 14 % by adopting a compact joint design while maintaining the same joint tensile strength (3.92 MN/m or higher). **Figure 1** shows the cross-sectional shape and product standard of JFESP-FLJ. The new JFESP-FLJ can be installed with workability equal to that of the conventional FL type by the same press-in method or vibro hammer method.

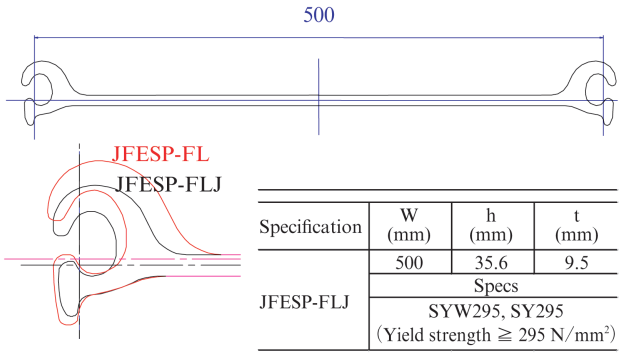
In addition to the fields of river improvement and port and harbor facilities, in which the steel sheet pile cell method has mainly been used, the applications of JFESP-FLJ have expanded in recent years, and now include use in shafts and retaining walls in the underground civil engineering field, where needs include construction under environmental restrictions such as shortening of the construction period and at narrow construction sites. This report introduces diverse construction products and their application methods using JFESP-FLJ.

2. Construction Products and Application Methods Using JFESP-FLJ™

2.1 Steel Sheet Pile Cell Method and Ring Method

The steel sheet pile cell method is a method for construction of river and port structures such as revetments by installing straight-shaped steel sheet piles assembled in an arc or cylindrical shape into water bottom in advance to form a retaining wall at the time of land reclamation (**Fig. 2**). This method can contribute to shortening the construction period because rapid construction is possible by using prefabricated members, and has already been adopted in the revetment structures of large-scale construction projects including the Tokyo Aqua-Line (Trans-Tokyo Bay Expressway) and Kansai International Airport, which was constructed on an artificial island. Cells structures using straight-shaped steel sheet piles are also employed in the erosion control field as cell dams as a sediment disaster prevention measure for debris flows (mudslides, etc.).

The steel sheet pile ring method is a type of reinforcing method for the foundation of existing structures such as so-called "old law" tanks (tanks con-



Specification	W (mm)	h (mm)	t (mm)
JFESP-FLJ	500	35.6	9.5
	Specs		
	SYW295, SY295 (Yield strength ≧ 295 N/mm²)		

Fig. 1 Cross-sectional shape and property of JFESP-FLJ™

Fig. 2 Steel sheet pile cell method

† Originally published in *JFE GIHO* No. 48 (Aug. 2021), p. 106−108

structed under standards based on a former law). In this method, straight-shaped steel sheet piles are driven in a ring shape so as to surround the outer circumference of the foundation from aboveground, and an integrated structure is created by installing a concrete coping on the head of the piles. When an earthquake occurs, the occurrence of liquefaction is reduced by suppressing the shear deformation of the ground surrounded by the ring (liquefaction countermeasure), and even in case liquefaction occurs, subsidence of the foundation ground is reduced by preventing lateral outflow of the liquefied soil (lateral flow countermeasure). Because straight-shaped steel sheet piles are a type of integrated temporary and main structure which plays the role of temporary coffering, a more compact construction space and shortening of the construction period are possible.

In the steel sheet pile cell method and ring method, the structure is to give resistance against external forces by filling the interior of the cell structure constructed using straight-shaped steel sheet piles with sand or crushed stone and concrete, but as a result, large tensile force is generated in the joints between the straight-shaped steel sheet piles. Therefore, an economical section design can be achieved by using JFESP-FLJ while utilizing the excellent tensile strength characteristics of this product.

2.2 Jacket-Type Quay with Arc-Shaped Retaining Wall Method

The jacket-type quay with arc-shaped retaining wall method provides a rational port structure which integrates a straight-shaped steel sheet pile wall (earth-retaining structure) arranged on an arc on the back side, and a jacket-type quay on the front side (**Fig. 3**). The high tensile strength of straight-shaped steel sheet piles can be utilized effectively in this structure because the earth pressure on the back side is supported by the tensile force (hoop tension) in the inner circumferential direction by arranging the straight-shaped steel sheet piles on an arc. Although the "sheet pile structure as an earth-retaining facility" and "quay as a mooring facility" had been independent in the conventional method, integration of these two structures in this construction method makes it possible to install the jacket and construct the sheet pile work continuously, and as a result, resulting in a shorter construction period. Moreover, in comparison with conventional structures using a steel pipe sheet pile retaining wall, etc., a reduction in the total weight of steel materials can be realized by using JFESP-FLJ.

2.3 Urban Wall™ Method

The Urban Wall™ method utilizes a segmented composite retaining wall that was developed to support large sections with diameters of approximately 30 to 50 m (**Fig. 4**). The steel pieces of the inner and outer rings, which are fabricated in the shop, are assembled in one-ring units at the site, the inner and outer rings are connected with splicing materials, and concrete is poured between the rings at the site to create a composite wall structure. Underground structures such as large diameter and large depth shafts are constructed efficiently by repeating this process of ring connection, concrete pouring, and press-in work. The joint structure between the pieces is assembled by directly welding the joints of the JFESP-FLJ piles to a skin plate. The high tensile strength used in the other methods described above, and the excellent workability of JFESP-FLJ, which enables completion of joining of joints simply by insertion, are also utilized in construction.

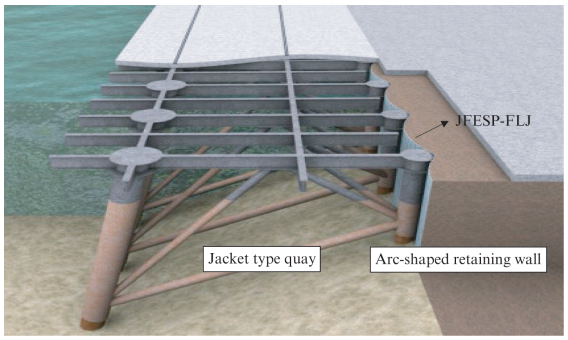


Fig. 3 Jacket type quay with arc-shaped retaining wall

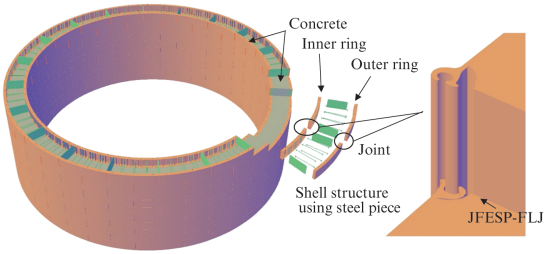


Fig. 4 Ring structure named Urban Wall™

The construction methods introduced up to this point are products and application methods that effectively utilize the tensile strength characteristics of straight-shaped steel sheet piles and JFESP-FLJ. To date, JFE Steel has accumulated construction results of many construction projects, centering on river improvement and port and harbor facilities. On the other hand, J-domer™, which is introduced in the following, is a product in flexural rigidity is expected in the structure itself by utilizing JFESP-FLJ as a member of the

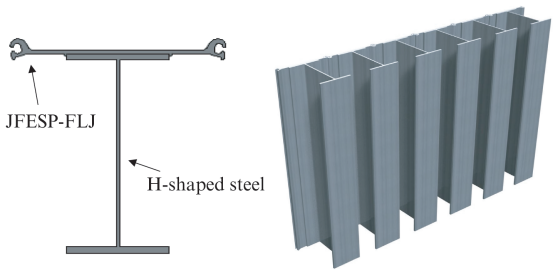


Fig. 5 Cross-sectional shape and image of J-domer™

retaining wall body, addressing needs in the underground civil engineering field.

2.4 J-domer™ (Steel Retaining Wall)

In construction projects in urban areas, the construction frequently must be carried out in the presence of existing structures, and the work is also subject to restrictions on construction space and time. Particularly in underground civil construction for construction of open cut tunnels and retaining walls, construction of the structure at a narrow site and a thinner structure as such are also demanded.

J-domer™ is a high rigidity steel wall structure that responds to these needs of recent years. JFESP-FLJ and H-shaped steel are combined as shown in **Fig. 5**, and a rational continuous wall with high water-tightness is constructed by installing the structure in the ground while fitting the joints at the two flanges of JFESP-FLJ at the site. Because the vibro-hammer method and the press-in method employing a low noise, low vibration type press-in machine can be used when installing J-domer, environment-friendly construction using a press-in machine is possible. In contrast to the conventional construction methods such as soil cement wall and steel pipe sheet pile retaining wall, a thinner wall with the same rigidity and compact construction are possible. Thus, J-domer is a suitable retaining wall construction method for sites with limited land and space, such as other neighboring and narrow sites and sites with overhead space restrictions in roads, railways and rivers construction.

3. Conclusion

In the future, JFE Steel will continue its efforts to disseminate and enhance the product appeal of the new straight-shaped steel sheet pile JFESP-FLJ and application methods that utilize its tensile strength characteristics in order to provide technologies that meet the diverse construction needs of the world.

"Urban Wall™" is a registered trademark of JFE Metal Products Corporation and Kato Construction Co., Ltd.

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