

[Document Type] Specification

[Title of the Invention] COMBINED STEEL SHEET PILE CONNECTION JIG AND
COMBINED STEEL SHEET PILE CONNECTION METHOD

[Technical Field of the Invention]

[0001]

The present invention relates to a combined steel sheet pile connection jig and a combined steel sheet pile connection method.

Priority is claimed on Japanese Patent Application No. 2014-004311, filed on January 14, 2014, the content of which is incorporated herein by reference.

[Related Art]

[0002]

Hitherto, in civil engineering and construction fields, when a retaining wall for preventing landslides or a revetment in a river is constructed, a U-shaped, Z-shaped, straight web-type, or hat-shaped steel sheet pile is mainly used. In addition, during civil engineering and construction works, a continuous wall (wall structure) constituted by a plurality of steel sheet piles is constructed by driving a plurality of steel sheet piles on the ground while allowing the fitting portions thereof to be fitted to each other. Here, as a general method for enhancing the structural resistance of this wall structure, there are a method of enhancing sectional performance by increasing the sectional size of steel sheet piles, and a method of using a combined steel sheet pile formed by combining a steel sheet pile with H-section steel or CT steel as a main structural member.

[0003]

For example, a combined steel sheet pile formed by combining a hat-shaped steel sheet pile with H-section steel as a main structural member is used to construct a continuous wall (refer to Patent Documents 1 to 3). A combined steel sheet pile has high flexural rigidity and high flexural capacity, and is less likely to be bent by external forces such as earth pressure and water pressure exerted in a direction perpendicular to the longitudinal direction (driving direction) thereof. Therefore, even in a case of using a long steel sheet pile, the combined steel sheet pile can withstand external forces. Therefore, hitherto, combined steel sheet piles have frequently been used as a retaining wall supported by an anchor or struts, or a free-standing retaining wall.

[0004]

Here, for example, in a case where a combined steel sheet pile is used as a retaining wall using struts in order to construct a reinforced concrete box culvert or the like by excavating the ground in a land site, the underground portion of the retaining

wall which is on the side beneath the excavation bottom surface tends to have a lower bending moment applied to the retaining wall than that of the front excavation portion of the retaining wall which is on the side above the excavation bottom surface.

Therefore, in order to achieve a reduction in manufacturing costs of the combined steel sheet pile, a combined steel sheet pile in which a main structural member is combined with a hat-shaped steel sheet pile having a shorter length than that of the main structural member to allow the lower end of the hat-shaped steel sheet pile to be disposed above the lower end of the main structural member may be used. In this case, in the front excavation portion of the retaining wall, the hat-shaped steel sheet pile and the main structural member withstand loads, and in the underground portion of the retaining wall, only the main structural member withstands loads.

[Citation List]

[Patent Document]

[0005]

[Patent Document 1] Japanese Unexamined Patent Application, First Publication No. 2002-212943

[Patent Document 2] Japanese Unexamined Patent Application, First Publication No. 2013-019245

[Patent Document 3] Japanese Unexamined Patent Application, First Publication No. 2009-019372

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0006]

In a case where a continuous wall is configured by connecting a plurality of combined steel sheet piles, in which the steel sheet pile length (the length of the steel sheet pile) is shorter than that of the main structural member, under the ground below the ground level (GL) of the original ground, in an existing method, a plurality of steel sheet piles are sequentially driven while fitting, to the fitting portion of a combined steel sheet pile that is driven first, the fitting portion of a combined steel sheet pile to be driven next, in midair. Hereinafter, the existing method in which a continuous wall is configured by connecting a plurality of combined steel sheet piles under the ground below the ground level of the original ground will be described with reference to FIGS. 22A to 22D.

[0007]

In the existing method, first, as shown in FIG. 22A, a combined steel sheet pile 1 is driven partway into the ground by a driving equipment. Thereafter, as shown in

FIG. 22B, a fitting portion 14 of a combined steel sheet pile 1X to be driven next is fitted to a fitting portion 14 (joint portion) of the combined steel sheet pile 1 from above. At this time, a scaffold 60 is placed adjacent to the combined steel sheet pile 1, and the fitting portions 14 of the combined steel sheet pile 1 and the combined steel sheet pile 1X are fitted to each other.

[0008]

Next, as shown in FIG. 22C, while the fitting portion 14 of the combined steel sheet pile 1X is fitted to the fitting portion 14 of the combined steel sheet pile 1, the combined steel sheet pile 1X is driven partway into the ground by the driving equipment. Thereafter, as shown in FIG. 22D, the scaffold 60 is moved to be adjacent to the combined steel sheet pile 1X, and a combined steel sheet pile 1Y to be driven next is driven partway into the ground by the driving equipment while fitting the fitting portion 14 of the combined steel sheet pile 1Y to the fitting portion 14 of the combined steel sheet pile 1X. The operations of FIGS. 22A to 22D are repeated to drive a predetermined number of combined steel sheet piles, and thereafter these combined steel sheet piles are finally driven to a predetermined depth under the ground.

[0009]

As described above, in the existing method, after the plurality of combined steel sheet piles are driven partway into the ground to be provided in a panel shape, the plurality of combined steel sheet piles need to be finally driven to a predetermined depth under the ground. Therefore, after the plurality of combined steel sheet piles are sequentially driven partway into the ground while moving the driving equipment, the plurality of combined steel sheet piles need to be sequentially driven to the predetermined depth while moving the driving equipment again. That is, the plurality of combined steel sheet piles need to be driven by the driving equipment in two stages, and thus there is a problem of an increase in time and effort during the connection operation.

[0010]

The present invention has been made in consideration of the above circumstances, and an object thereof is to provide a combined steel sheet pile connection jig and a combined steel sheet pile connection method in which efficiency improvement in an operation of connecting a plurality of combined steel sheet piles can be achieved.

[Means for Solving the Problem]

[0011]

In order to solve the problems, the present invention adopts the following.

(1) According to an aspect of the present invention, a combined steel sheet pile connection jig which is used by being attached to an upper edge of a combined steel sheet pile when a plurality of combined steel sheet piles, each of which including a pair of parallel arm portions and fitting portions respectively provided for the arm portions, are connected to one another by connecting the fitting portions, includes: a guide portion having the same shape as that of the fitting portion; a first positioning portion which comes into sliding contact with the pair of arm portions along an arrangement direction of the pair of arm portions; a second positioning portion which restricts further movement of the guide portion when the guide portion is moved along the arrangement direction and is aligned at a position relative to the fitting portion; and an abutting portion which abuts the upper edge.

(2) In the aspect described in (1), a first notch which is provided in an upper end portion of the guide portion and has an abutting surface that abuts the fitting portion may be further included.

(3) In the aspect described in (2), the first notch may further include a pair of guide surfaces which allow the abutting surface to be interposed therebetween, and spread out from the abutting surface.

(4) In the aspect described in any one of (1) to (3), an end portion of the abutting portion may include a second notch.

(5) In the aspect described in any one of (1) to (4), the first positioning portion and the second positioning portion may protrude downward in a vertical direction from a lower edge of the abutting portion, and a protruding length of the first positioning portion may be longer than a protruding length of the second positioning portion.

(6) In the aspect described in any one of (1) to (4), the first positioning portion and the second positioning portion may protrude downward in a vertical direction from a lower edge of the abutting portion, and a protruding length of the first positioning portion may be shorter than a protruding length of the second positioning portion.

(7) In the aspect described in any one of (1) to (6), a fixed portion fixed to the combined steel sheet pile may be further included.

(8) According to another aspect of the present invention, a combined steel sheet pile connection method is a method of connecting a plurality of combined steel sheet piles using the combined steel sheet pile connection jig described in any one of (1) to (7), including: a first driving process of driving the combined steel sheet pile; a positioning process of moving the combined steel sheet pile connection jig until movement of the guide portion is restricted by the second positioning portion while the first positioning portion is allowed to come into sliding contact with the pair of arm

portions of the combined steel sheet pile after the first driving process and thereafter allowing the abutting portion to abut the upper edge of the combined steel sheet pile; and a second driving process of driving another combined steel sheet pile while fitting the fitting portion of the other combined steel sheet pile to the guide portion and subsequently to the fitting portion of the other combined steel sheet pile after the positioning process.

[Effects of the Invention]

[0012]

According to the combined steel sheet pile connection jig described in (1), since the first positioning portion which comes into sliding contact with the pair of arm portions along the arrangement direction of the pair of arm portions is included, the guide portion can be moved along the arrangement direction of the arm portions while allowing the guide portion to be aligned at the position relative to the fitting portion in a direction perpendicular to the arrangement of the arm portions. In addition, since the second positioning portion which restricts the movement of the guide portion along the arrangement direction of the arm portions is included, positioning of the guide portion with respect to the fitting portion in the arrangement direction of the arm portions can be performed. In addition, since the abutting portion which abuts the upper edge of the combined steel sheet pile is included, positioning of the guide portion with respect to the fitting portion in a vertical direction can be performed. Accordingly, the combined steel sheet pile connection jig can be attached to the combined steel sheet pile to allow the guide portion having the same shape as that of the fitting portion to be connected to the fitting portion, and thus the length of the fitting portion can be increased. As a result, even when combined steel sheet piles in which a main structural member protrudes from one end of a steel sheet pile is used, the combined steel sheet piles do not need to be driven in two stages when combined steel sheet piles are connected to one another. Therefore, the operation of connecting the combined steel sheet piles can be efficiently performed.

[0013]

In the case of (2), since the first notch which is provided in the upper end portion of the guide portion and has the abutting surface that abuts the fitting portion is included, the fitting portion can be moved from a side of the guide portion to abut the abutting surface. Therefore, positioning of the fitting portion with respect to the guide portion can be performed by moving the fitting portion from the side of the guide portion. Accordingly, there is no need to use a scaffold when the operation of connecting the combined steel sheet piles is performed, and thus the operation of

connecting the combined steel sheet piles can be more efficiently performed.

[0014]

In the case of (3), since the first notch includes the pair of guide surfaces which allow the abutting surface to be interposed therebetween, and spread out from the abutting surface is included, when the fitting portion is allowed to abut the abutting surface, the fitting portion is induced to the abutting surface by the pair of guide surfaces. Therefore, the fitting portion can be smoothly allowed to abut the abutting surface, and thus the operation of connecting the combined steel sheet piles can be more efficiently performed.

[0015]

In the case of (4), since the end portion of the abutting portion includes the second notch, the width of the abutting portion can be smaller than the width of the combined steel sheet pile. Therefore, when the combined steel sheet pile connection jig is attached to the combined steel sheet pile, even in a case where the combined steel sheet pile driven first does not reach a target driving depth, the abutting portion can be prevented from interfering with the combined steel sheet pile driven first.

[0016]

In the case of (5), since the protruding length of the first positioning portion is longer than the protruding length of the second positioning portion, when the first positioning portion is allowed to come into sliding contact with the pair of arm portions, the second positioning portion can be prevented from interfering with the upper edge of the combined steel sheet pile. Therefore, positioning of the guide portion and the fitting portion can be easily performed, and thus the operation of connecting the combined steel sheet piles can be more efficiently performed.

[0017]

In the case of (6), since the protruding length of the first positioning portion is shorter than the protruding length of the second positioning portion, the combined steel sheet pile connection jig can be disposed at a position at which the second positioning portion does not interfere with the upper edge of the combined steel sheet pile before the first positioning portion comes into sliding contact with the pair of arm portions. Therefore, when the first positioning portion is allowed to come into sliding contact with the pair of arm portions, the second positioning portion can be prevented from interfering with the upper edge of the combined steel sheet pile. Accordingly, positioning of the guide portion and the fitting portion is easily performed, and thus the operation of connecting the combined steel sheet piles can be more efficiently performed.

[0018]

In the case of (7), since the fixed portion fixed to the combined steel sheet pile is included, a positional shift of the guide portion with respect to the combined steel sheet pile, which may occur due to the frictional resistance or the like of the guide portion when the fitting portions of the plurality of combined steel sheet piles are connected, can be prevented.

[0019]

According to the combined steel sheet pile connection method described in (8), since the combined steel sheet pile connection jig is moved until movement of the guide portion is restricted by the second positioning portion while the first positioning portion is allowed to come into sliding contact with the pair of arm portions of the combined steel sheet pile and thereafter the abutting portion is allowed to abut the upper edge of the combined steel sheet pile, the combined steel sheet pile connection jig can be attached to the combined steel sheet pile so as to connect the guide portion and the fitting portion to each other. Therefore, the length of the fitting portion can be increased. Accordingly, even when combined steel sheet piles in which a main structural member protrudes from one end of a steel sheet pile is used, the operation of connecting the combined steel sheet piles can be efficiently performed.

[Brief Description of the Drawings]

[0020]

FIG. 1 is a schematic perspective view showing a state in which a combined steel sheet pile connection jig according to a first embodiment of the present invention is attached to a combined steel sheet pile.

FIG. 2A is a plan view showing the combined steel sheet pile.

FIG. 2B is a front view showing the combined steel sheet pile.

FIG. 3 is a front view showing the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 4A is a cross-sectional view taken along line A-A of FIG. 3, and is a view showing the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 4B is a cross-sectional view taken along line B-B of FIG. 3, and is a view showing the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 4C is a cross-sectional view taken along line C-C of FIG. 3, and is a view showing the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 5 is a view viewed in a D direction of FIG. 3 and is a view showing a pair of first guide plates.

FIG. 6 is a front view showing a state in which the combined steel sheet pile connection jig according to the first embodiment of the present invention is attached to the combined steel sheet pile.

FIG. 7A is a view showing a method of attaching the combined steel sheet pile connection jig according to the first embodiment of the present invention to the combined steel sheet pile.

FIG. 7B is a view showing a method of attaching the combined steel sheet pile connection jig according to the first embodiment of the present invention to the combined steel sheet pile.

FIG. 7C is a view showing a method of attaching the combined steel sheet pile connection jig according to the first embodiment of the present invention to the combined steel sheet pile.

FIG. 8 is a cross-sectional view taken along line E-E of FIG. 7C, and is a view showing a state in which the combined steel sheet pile connection jig according to the first embodiment of the present invention is attached to the combined steel sheet pile.

FIG. 9 is a partial enlarged side view of the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 10A is a view showing a method of driving a plurality of combined steel sheet piles using the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 10B is a view showing the method of driving a plurality of combined steel sheet piles using the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 10C is a view showing the method of driving a plurality of combined steel sheet piles using the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 11 is a plan view showing the combined steel sheet pile connection jig according to the first embodiment of the present invention, and is a view showing a state in which a fitting portion of the combined steel sheet pile is allowed to abut an abutting surface.

FIG. 12 is a side view showing the combined steel sheet pile, guide frames, and a spacer.

FIG. 13A is a view showing the method of driving a plurality of combined steel sheet piles using the combined steel sheet pile connection jig according to the first

embodiment of the present invention.

FIG. 13B is a view showing the method of driving a plurality of combined steel sheet piles using the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 13C is a view showing the method of driving a plurality of combined steel sheet piles using the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 13D is a view showing the method of driving a plurality of combined steel sheet piles using the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 14A is a front view showing a modification example of the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 14B is a cross-sectional view taken along line F-F of FIG. 14A.

FIG. 15 is a cross-sectional view taken along line C-C of FIG. 3, and is a view showing a modification example of the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 16 is a cross-sectional view taken along line C-C of FIG. 3, and is a view showing a modification example of the combined steel sheet pile connection jig according to the first embodiment of the present invention.

FIG. 17 is a front view showing a combined steel sheet pile connection jig according to a second embodiment of the present invention.

FIG. 18A is a partial enlarged front view showing the combined steel sheet pile connection jig according to the second embodiment of the present invention.

FIG. 18B is a cross-sectional view taken along line G-G of FIG. 18A.

FIG. 19A is a view showing a method of attaching the combined steel sheet pile connection jig according to the second embodiment of the present invention to a combined steel sheet pile.

FIG. 19B is a view showing the method of attaching the combined steel sheet pile connection jig according to the second embodiment of the present invention to a combined steel sheet pile.

FIG. 19C is a view showing the method of attaching the combined steel sheet pile connection jig according to the second embodiment of the present invention to a combined steel sheet pile.

FIG. 20 is a front view showing a combined steel sheet pile connection jig according to a third embodiment of the present invention.

FIG. 21A is a partial enlarged front view showing the combined steel sheet pile

connection jig according to the third embodiment of the present invention.

FIG. 21B is a cross-sectional view taken along line H-H of FIG. 21A.

FIG. 22A is a view showing a method of driving a plurality of combined steel sheet piles according to the related art.

FIG. 22B is a view showing the method of driving a plurality of combined steel sheet piles according to the related art.

FIG. 22C is a view showing the method of driving a plurality of combined steel sheet piles according to the related art.

FIG. 22D is a view showing the method of driving a plurality of combined steel sheet piles according to the related art.

[Embodiments of the Invention]

[0021]

Hereinafter, each embodiment of the present invention will be described in detail with reference to the drawings. In this specification and the drawings, like elements having substantially the same functions and configurations are denoted by like reference numerals, and overlapping description thereof will be omitted.

[0022]

(First Embodiment)

First, a combined steel sheet pile connection jig 100 according to a first embodiment of the present invention will be described. FIG. 1 is a schematic perspective view showing the combined steel sheet pile connection jig 100 according to this embodiment. As shown in FIG. 1, the combined steel sheet pile connection jig 100 is attached to the upper end (upper edge) of a steel sheet pile 10 of a combined steel sheet pile 1 when a continuous wall 5 is constructed in the ground. The continuous wall 5 is formed by driving a plurality of combined steel sheet piles 1 into the ground while fitting the fitting portions 14 thereof to one another.

In FIG. 1, an X direction represents a wall structure direction (width direction), a Y direction represents a height direction (a material axis direction, a direction in which combined steel sheet piles are driven, or a vertical direction), and a Z direction represents a direction perpendicular to the wall structure direction X. Reference numeral GL represents the ground level.

[0023]

FIG. 2A is a plan view showing the combined steel sheet pile 1, and FIG. 2B is a front view showing the combined steel sheet pile 1. As shown in FIG. 2A, the combined steel sheet pile 1 is constituted by a hat-shaped steel sheet pile 10 (steel sheet pile) and H-section steel 20 (main structural member). In the combined steel sheet pile

1, the H-section steel 20 is fixed to the surface of the rear side of a web portion 11 of the hat-shaped steel sheet pile 10 by welding or the like, and the hat-shaped steel sheet pile 10 and the H-section steel 20 are combined with each other. In the following description, as shown in FIG. 2A, one surface of the surfaces of the web portion 11 in the Z direction to which the H-section steel 20 is welded is called a rear side (outer side), and the other surface thereof is called a front side (inner side). Hereinafter, the same is applied throughout the specification.

[0024]

The hat-shaped steel sheet pile 10 includes the web portion 11, a pair of flange portions 12 provided at both end portions of the web portion 11, a pair of arm portions 13 respectively provided at the end portions of the pair of flange portions 12, and a pair of fitting portions 14 (joint portions) respectively provided at the end portions of the pair of arm portions 13. The arm portions 13 forming a pair are parallel to each other and are arranged in a straight line along the X direction.

The H-section steel 20 includes a web portion 22 and a pair of flange portions 21 provided at both end portions of the web portion 22.

[0025]

In addition, as shown in FIG. 2B, in the combined steel sheet pile 1, the position of the lower end of the hat-shaped steel sheet pile 10 is disposed above (on the upper side in the Y direction) the position of the lower end of the H-section steel 20, and the H-section steel 20 protrudes downward (toward the lower side in the Y direction) from the lower end of the hat-shaped steel sheet pile 10 by a protruding length L1. The protruding length L1 is, for example, 50 cm to 5 m.

[0026]

FIG. 3 is a front view showing the combined steel sheet pile connection jig 100. As shown in FIG. 3, the combined steel sheet pile connection jig 100 includes a jig 110, first guide plates 150, a second guide plate 160, and third guide plates 170. The first guide plates 150, the second guide plate 160, and the third guide plates 170 are provided in an abutting portion 116 (lower end portion) of the jig 110 and protrude toward the lower side in the Y direction from a lower end 116a (lower edge) of the abutting portion 116. In this embodiment, the protruding lengths of the first guide plates 150, the second guide plate 160, and the third guide plates 170 are the same, and for example, are 100 mm.

[0027]

The jig 110 includes a web portion 111, a pair of flange portions 112 provided at both end portions of the web portion 111, a pair of arm portions 113 respectively

provided at the end portions of the pair of flange portions 112, and a pair of guide portions 114 respectively provided at the end portions of the pair of arm portions 113. The planar shape of the jig 110 is the same as the shape of the steel sheet pile 10 used in the combined steel sheet pile 1. In addition, “the same shape” means that the shape of the transverse section (the section parallel to the X direction in FIG. 3) of the jig 110 is the same as the transverse section of the steel sheet pile 10 used in the combined steel sheet pile 1.

[0028]

That is, in the jig 110, the web portion 111, the flange portions 112, the arm portions 113, and the guide portions 114 respectively have the same shapes as those of the web portion 11, the flange portions 12, the arm portions 13, and the fitting portions 14 of the steel sheet pile 10 used in the combined steel sheet pile 1.

[0029]

The arm portions 113 forming a pair in the jig 110 are parallel to each other and are arranged in a straight line along the X direction. In addition, the upper end portion of the web portion 111 of the jig 110 is provided with, for example, a single hanging hole 111a used to lift the combined steel sheet pile connection jig 100. When the combined steel sheet pile connection jig 100 is lifted, a wire or hook may be passed through the hanging hole 111a and the combined steel sheet pile connection jig 100 may be lifted by a machine such as a winch. Otherwise, the hanging hole 111a may also be provided in the flange portion 112 or the arm portion 113. However, it is preferable that the hanging hole 111a is provided on a straight line that passes through the center of gravity of the combined steel sheet pile connection jig 100 and is parallel to the longitudinal direction of the jig 110 at a position closer to the upper end of the jig 110 than the center of gravity so as not to allow the jig 110 to be inclined with respect to the Y direction when lifted.

[0030]

The jig 110 may have the same shape as that of the hat-shaped steel sheet pile 10 used in the combined steel sheet pile 1. That is, regarding the hat-shaped steel sheet pile 10 used in the combined steel sheet pile 1, a hat-shaped steel sheet pile manufactured through integration type hot rolling or cold forming may be used as the jig 110, or a hat-shaped steel sheet pile in which two Z-section steel sheet piles manufactured through a hot rolling or cold forming process are fitted to each other and are fixed to each other by welding, caulking, or the like may be used as the jig 110.

[0031]

When the combined steel sheet pile connection jig 100 is attached to the

combined steel sheet pile 1, the lower end 116a (lower edge) of the abutting portion 116 of the jig 110 abuts an upper end 15a (upper edge) of the steel sheet pile 10. Therefore, the position of the combined steel sheet pile connection jig 100 in the Y direction with respect to the combined steel sheet pile 1 is determined.

[0032]

The jig 110 includes a notch 120 (first notch) formed by cutting out one upper end portion of the pair of guide portions 114 toward a side (the X direction). The length L2 of the notch 120 in the Y direction is, for example, about 50 cm to 1 m.

[0033]

In addition, the jig 110 includes a notch 130 (second notch) formed by cutting out the lower end portion (the end portion of the abutting portion 116) of the arm portion 113 on the side opposite to the notch 120 in the pair of arm portions 113, toward the side. The length of the notch 130 in the Y direction is, for example, about 50 cm to 1 m.

[0034]

FIG. 4A is a cross-sectional view taken along line A-A of FIG. 3, and FIG. 4B is a cross-sectional view taken along line B-B of FIG. 3. As shown in FIGS. 4A and 4B, the notch 120 is formed by cutting guide portion 114 to allow an inner surface 114a of the guide portion 114 to be exposed in the X direction. In addition, a pair of fourth guide plates 121 are provided in the notch 120 such that guide surfaces 121a thereof allow an inner surface 120a (abutting surface) of the notch 120 to be interposed between, and spread out from the inner surface 120a as the center. The pair of fourth guide plates 121 are fixed to the notch 120 by fillet welding or the like. That is, a weld portion 123 is provided in the fourth guide plate 121 and the notch 120. In addition, it is preferable that the pair of fourth guide plates 121 and the notch 120 form a V shape in a case where the combined steel sheet pile connection jig 100 is in a plan view.

[0035]

The fourth guide plate 121 is manufactured, for example, using a steel sheet having a sheet thickness of 9 mm, a width of 100 mm to 200 mm, and an overall length that is substantially the same as the length L2 of the notch 120. In addition, as the fourth guide plate 121, a single steel sheet may be used, a steel sheet subjected to bending (bent sheet) may be used, or two or more steel sheets which are welded to have an obtuse crossing angle may be used.

[0036]

FIG. 4C is a cross-sectional view taken along line C-C of FIG. 3. As shown in FIG. 4C, in the abutting portion 116 of the jig 110, the first guide plates 150 (first

positioning portions) forming a pair are respectively provided in the pair of arm portions 113 so as to protrude from the arm portions 113 toward both sides in the Z direction. The pair of first guide plates 150 are fixed to the arm portions 113 by fillet welding or the like.

FIG. 5 is a side view viewed in a D direction of FIG. 3 and is a view showing the pair of first guide plates 150. As shown in FIG. 5, the pair of first guide plates 150 protrude toward the lower side in the Y direction from the lower end 116a of the abutting portion 116 and pinch (come into sliding contact with) the arm portions 13 of the steel sheet pile 10 when the combined steel sheet pile connection jig 100 is attached to the combined steel sheet pile 1. As a result, the position of the jig 110 in the Z direction with respect to the steel sheet pile 10 is determined.

In addition, the number of pairs of the first guide plates 150 is not limited to two, and may be one, or three or more.

[0037]

In addition, as shown in FIG. 4C, in the abutting portion 116 of the jig 110, the second guide plate 160 (second positioning portion) is provided in the guide portion 114. The second guide plate 160 is fixed to the corner portion of a C-shaped curved portion 114b of the guide portion 114 by fillet welding or the like, and protrudes toward the lower side in the Y direction from the lower end 116a of the abutting portion 116 similar to the first guide plate 150 (see FIG. 3). The second guide plate 160 abuts the fitting portion 14 of the steel sheet pile 10 when the combined steel sheet pile connection jig 100 is attached to the combined steel sheet pile 1. As a result, the position of the jig 110 in the X direction with respect to the steel sheet pile 10 is determined.

[0038]

In addition, as shown in FIG. 4C, in the abutting portion 116 of the jig 110, three third guide plates 170 (third positioning portions) are provided in the web portion 111 and the pair of flange portions 112. The third guide plates 170 are fixed to the front side of the web portion 111 and the rear side of the pair of flange portions 112 and protrude downward in the Y direction from the lower end 116a of the abutting portion 116 similar to the first guide plates 150 and the second guide plate 160 (see FIG. 3). In addition, the third guide plates 170 pinch the web portion 11 and the flange portions 12 of the steel sheet pile 10 when the combined steel sheet pile connection jig 100 is attached to the combined steel sheet pile 1. As a result, the position of the jig 110 in the X direction and the Z direction with respect to the steel sheet pile 10 is determined.

[0039]

Each of the first guide plates 150, the second guide plate 160, and the third

guide plates 170 is manufactured, for example, using a steel sheet having a width of 50 mm, a sheet thickness of 9 mm, and an overall length of 200 mm.

[0040]

As shown in FIG. 5, an upper portion 150a of the first guide plate 150 is fixed to the abutting portion 116 by welding or the like, and a lower portion 150b of the first guide plate 150 protrudes downward in the Y direction from the lower end 116a of the abutting portion 116. The length of the upper portion 150a of the first guide plate 150 is, for example, 100 mm. The lower end portion of the lower portion 150b of the first guide plate 150 is provided with, for example, a tapered portion 150d having a length of 30 mm to 50 mm. Since the tapered portion 150d is provided as described above, an operation of attaching the combined steel sheet pile connection jig 100 to the steel sheet pile 10 can be easily performed. In addition, a stepped portion 150c is provided between the upper portion 150a and the lower portion 150b of the first guide plate 150 so that a gap d is provided between a side end surface 150e of the lower portion 150b of the first guide plate 150 and a side surface 10a of the steel sheet pile 10 when the combined steel sheet pile connection jig 100 is attached to the combined steel sheet pile 1.

In addition, the second guide plate 160 and the third guide plates 170 have the same shape as that of the first guide plates 150.

[0041]

The first guide plates 150 and the second guide plate 160 have a relatively small gap d of, for example, 1 mm or greater and 2 mm or smaller. On the other hand, the third guide plates 170 have a relatively large gap d of, for example, 2 mm or greater and 5 mm or smaller.

[0042]

FIG. 6 is a front view showing a state in which the combined steel sheet pile connection jig 100 is attached to the combined steel sheet pile 1 driven into the ground. As described later, the combined steel sheet pile connection jig 100 is attached to the upper end of the steel sheet pile 10 of the combined steel sheet pile 1 so that the guide portion 114 and the fitting portion 14 overlap each other in a case of being viewed in the Y direction. Here, the overall length L[m] of the jig 110 is determined to satisfy the following Expression (1).

$$L \geq L1 + L2 - L3 \quad \dots(1)$$

In addition, L1 is the protruding length [m] of the H-section steel 20 of the combined steel sheet pile 1, L2 is the notch length [m] of the notch 120, and L3 is the protruding length [m] of the combined steel sheet pile 1 from the ground level GL.

That is, in a case where the protruding length L1 is 3 m, the notch length L2 is 0.5 m, and the protruding length L3 is 1 m, the overall length L of the jig 110 is 2.5 m or longer.

[0043]

[Method of Connecting Combined Steel Sheet Piles]

Next, a method of connecting a plurality of combined steel sheet piles 1 in the ground using the combined steel sheet pile connection jig 100 according to this embodiment will be described.

[0044]

When the plurality of combined steel sheet piles 1 are connected to one another in the ground, first, the combined steel sheet pile 1 is driven into the ground. At this time, when the combined steel sheet pile 1 is driven, it is preferable that the upper end portion of the web portion 22 of the H-section steel 20 is held by the chuck of a vibratory hammer for the driving. Next, the combined steel sheet pile connection jig 100 is attached to the combined steel sheet pile 1. FIGS. 7A to 7C are views showing a method of attaching the combined steel sheet pile connection jig 100 to the combined steel sheet pile 1 and are front views showing the combined steel sheet pile connection jig 100 and the combined steel sheet pile 1. First, as shown in FIG. 7A, a wire is hooked through the hanging hole 111a and the combined steel sheet pile connection jig 100 is lifted. In addition, the combined steel sheet pile connection jig 100 is moved to the upper side of the steel sheet pile 10 driven into the ground, and the combined steel sheet pile connection jig 100 is lowered to a position at which the first guide plates 150, the second guide plate 160, and the third guide plates 170 do not come into contact with the upper end of the steel sheet pile 10.

[0045]

Next, as shown in FIG. 7B, the combined steel sheet pile connection jig 100 is further lowered to a position at which the lower end of the abutting portion 116 does not come into contact with the upper end of the steel sheet pile 10 so that the pair of first guide plates 150 pinch the arm portions 13 of the steel sheet pile 10 and the three third guide plates 170 pinch the flange portions 12 and the web portion 11 of the steel sheet pile 10. Thereafter, the combined steel sheet pile connection jig 100 is moved in the X direction until the second guide plate 160 abuts the steel sheet pile 10. At this time, as described above, a relatively large gap d of about 2 mm or greater and 5 mm or smaller is provided between the third guide plate 170 and the steel sheet pile 10, and relatively small gaps d of about 1 mm or greater and 2 mm or smaller are provided between the first guide plate 150 and the steel sheet pile 10 and between the second guide plate 160

and the steel sheet pile 10 (see FIG. 5). Therefore, the combined steel sheet pile connection jig 100 can be moved along the X direction (along the arrangement direction of the pair of arm portions 13 of the steel sheet pile 10) until the second guide plate 160 abuts the steel sheet pile 10. At a point of time when the operation shown in FIG. 7B is completed, positioning of the guide portion 114 of the combined steel sheet pile connection jig 100 in the X and Z directions with respect to the fitting portion 14 of the steel sheet pile 10 is completed.

[0046]

Next, as shown in FIG. 7C, the combined steel sheet pile connection jig 100 is moved downward in the Y direction until the lower end of the abutting portion 116 abuts the upper end of the steel sheet pile 10. Thereafter, the upright property of the combined steel sheet pile connection jig 100 in the Y direction, a positional shift of the combined steel sheet pile connection jig 100 in the X direction, and a small bend angle between the combined steel sheet pile connection jig 100 and the combined steel sheet pile 1 are confirmed, and the lower portion (protruding portion) of the third guide plate 170 is fixed to the steel sheet pile 10 by spot welding, fillet welding, or the like.

[0047]

FIG. 8 is a cross-sectional view taken along line E-E of FIG. 7C. As shown in FIG. 8, the combined steel sheet pile connection jig 100 is fixed to the steel sheet pile 10 by welding the lower portion of the third guide plates 170 to the steel sheet pile 10 through spot welding, fillet welding, or the like. That is, a weld portion 172 (fixed portion) is provided in the lower portion of the third guide plate 170. Therefore, a positional shift of the guide portion 114 of the combined steel sheet pile connection jig 100 with respect to the fitting portion 14 of the steel sheet pile 10 can be prevented. Otherwise, instead of welding, the third guide plate 170 and the steel sheet pile 10 may also be fixed to each other using bolts.

[0048]

As shown in FIG. 9, in the second guide plate 160, in a case where the distance between a side end surface 160e of the lower portion 160b and the fitting portion 14 of the steel sheet pile 10 significantly varies in the Y direction, the combined steel sheet pile connection jig 100 and the combined steel sheet pile 1 have a bend angle therebetween, and the joint resistance during driving becomes excessively high. Therefore, it is preferable that the distance between the fitting portion 14 of the steel sheet pile 10 and the side end surface 160e of the second guide plate 160 is constant in the Y direction by using a method of disposing a thin steel sheet in the upper end portion 15 of the steel sheet pile 10 or disposing weld beads.

[0049]

The guide portion 114 of the combined steel sheet pile connection jig 100 and the fitting portion 14 of the steel sheet pile 10 can be allowed to overlap each other when viewed in the Y direction by the operations shown in FIGS. 7A to 7C. As a result, the length of the fitting portion 14 of the steel sheet pile 10 can be increased in the Y direction.

[0050]

Here, in the combined steel sheet pile 1 in which the steel sheet pile 10 and the H-section steel 20 are joined to each other by welding, variations in the overall width (the distance between the fitting portions) of the steel sheet pile 10 occur. As a result of a weld test of the combined steel sheet pile 1, in a case where the sum of weld lengths is 60% of the length of the steel sheet pile, it was determined that the overall width of the steel sheet pile 10 is increased after welding by about 3 mm to 5 mm on average due to the thermal input during welding, constriction during cooling of weld metals, and the like and variations in the accuracy occur in a range of about 1 mm to 2 mm.

[0051]

However, in the method of attaching the combined steel sheet pile connection jig 100 shown in FIGS. 7A to 7C, the combined steel sheet pile connection jig 100 is allowed to move only in the X direction by using the fact that the pair of arm portions 13 of the steel sheet pile 10 are formed on a straight line along the X direction. Therefore, even in a case where variations in the combined steel sheet pile 1 occur as described above, the combined steel sheet pile connection jig 100 can be attached to the steel sheet pile 10 so that the fitting portion 14 of the steel sheet pile 10 and the guide portion 114 of the combined steel sheet pile connection jig 100 overlap in a case of being viewed in the Y direction.

[0052]

FIGS. 10A to 10C are views showing a method of driving a combined steel sheet pile 1X to be driven next while fitting the combined steel sheet pile 1X to the combined steel sheet pile 1 driven first after the operations shown in FIGS. 7A to 7C, and are front views showing the combined steel sheet pile connection jig 100, the combined steel sheet pile 1, and the combined steel sheet pile 1X. First, the combined steel sheet pile 1X is lifted by a crane so that the lower end of the combined steel sheet pile 1X is positioned between the upper end and the lower end of the fourth guide plate 121 of the combined steel sheet pile connection jig 100. Thereafter, as shown in FIG. 10A, the fitting portion 14 of the combined steel sheet pile 1X is inserted into a space

122 (see FIG. 11) interposed between the pair of fourth guide plates 121 by moving the combined steel sheet pile 1X in the X direction.

[0053]

FIG. 11 is a view showing the state shown in FIG. 10A viewed from above in the Y direction and is a view showing the combined steel sheet pile connection jig 100 and the combined steel sheet pile 1X. As shown in FIG. 11, the combined steel sheet pile 1X is moved in the X direction until the fitting portion 14 of the combined steel sheet pile 1X abuts the abutting surface 120a of the notch 120 of the combined steel sheet pile connection jig 100. At a point of time when the fitting portion 14 of the combined steel sheet pile 1X abuts the abutting surface 120a of the combined steel sheet pile connection jig 100, the position of the fitting portion 14 of the combined steel sheet pile 1X in the X and Z directions with respect to the guide portion 114 of the combined steel sheet pile connection jig 100 is determined. At this time, since the pair of fourth guide plates 121 are provided in the notch 120 of the combined steel sheet pile connection jig 100, the fitting portion 14 of the combined steel sheet pile 1X is induced to the abutting surface 120a of the combined steel sheet pile connection jig 100. Therefore, the fitting portion 14 of the combined steel sheet pile 1X can be allowed to easily abut the abutting surface 120a of the combined steel sheet pile connection jig 100.

[0054]

Here, in the related art, the fitting portions 14 need to be fitted to each other by a manual operation in order to connect the combined steel sheet pile 1 to the combined steel sheet pile 1X (see FIGS. 22B and 22D). However, in this embodiment, since the fitting portion 14 of the steel sheet pile 10 is inserted into the space 122 formed between the pair of fourth guide plates 121, the combined steel sheet pile 1X may only be moved in the X direction by a crane or the like. Therefore, in the operations shown in FIGS. 10A and 11, the scaffold 60 shown in FIGS. 22B and 22D does not need to be used.

[0055]

At a point of time of the operation shown in FIG. 10A, positioning of the guide portion 114 of the combined steel sheet pile connection jig 100 and the fitting portion 14 of the combined steel sheet pile 1X in the X and Z directions is completed. Therefore, the guide portion 114 of the combined steel sheet pile connection jig 100 and the fitting portion 14 of the combined steel sheet pile 1X can be fitted to each other by moving the combined steel sheet pile 1X downward in the Y direction.

[0056]

Next, as shown in FIG. 10B, the combined steel sheet pile 1X is driven while

the fitting portion 14 of the combined steel sheet pile 1X is fitted to the guide portion 114 and subsequently to the fitting portion 14 of the combined steel sheet pile 1. In addition, as shown in FIG. 10C, the combined steel sheet pile 1X is driven until the upper end of the combined steel sheet pile 1X becomes flush with the upper end of the combined steel sheet pile connection jig 100.

[0057]

When the operations shown in FIGS. 10A to 10C are performed, the position and direction of the H-section steel 20 of the combined steel sheet pile 1X in the Z direction are adjusted. Therefore, as shown in FIG. 12, it is preferable that H-shaped guide frames 40 and a spacer 50 are used. FIG. 12 is a side view showing the combined steel sheet pile 1X, the guide frames 40, and the spacer 50. In this case, in order to prevent the spacer 50 from interfering with a driving operation, the spacer 50 is detached from the guide frame 40 after the operation of driving the combined steel sheet pile 1X is started and the H-section steel 20 of the combined steel sheet pile 1X is driven into the ground to a certain degree. The guide frame 40 is, for example, H-section steel. The spacer 50 is manufactured, for example, by cutting 30 cm from a steel sheet pile in a longitudinal direction thereof.

[0058]

After the operations shown in FIGS. 10A to 10C, as shown in FIG. 13A, the combined steel sheet pile connection jig 100 is detached from the combined steel sheet pile 1. At this time, the weld portion 172 (see FIG. 8) by which the combined steel sheet pile connection jig 100 is fixed to the combined steel sheet pile 1 is cut by a grinder or the like. In addition, a wire is hooked through the hanging hole 111a and the combined steel sheet pile connection jig 100 is lifted. In this manner, the combined steel sheet pile connection jig 100 can be detached from the combined steel sheet pile 1.

[0059]

After the operation of detaching the combined steel sheet pile connection jig 100 is ended, as shown in FIG. 13B, the combined steel sheet pile 1X is further driven into the ground. At a point of time in which the combined steel sheet pile 1X is driven to a predetermined depth as shown in FIG. 13C, the operation of driving the combined steel sheet pile 1X is ended.

[0060]

At a point of time when the operation shown in FIG. 13C is ended, a continuous wall 5 including two steel sheet piles 10 is constructed in the ground. In a case where the operations are further performed and a continuous wall 5 having three or more steel sheet piles 10 is constructed in the ground, as shown in FIG. 13D, the

combined steel sheet pile connection jig 100 is attached to the combined steel sheet pile 1X and the same operations may be repeated. In this case, the combined steel sheet pile connection jig 100 detached in the operation shown in FIG. 13A can be reused. By reusing the combined steel sheet pile connection jig 100, costs can be reduced.

[0061]

In the case of reusing the combined steel sheet pile connection jig 100, welding and cutting are repeated. Therefore, deterioration of the third guide plates 170 is postulated. However, in the combined steel sheet pile connection jig 100, only the third guide plates 170 are welded to the combined steel sheet pile 1 (the jig 110 is not welded). Therefore, in a case where the third guide plates 170 are deteriorated, when the third guide plates 170 are replaced with new third guide plates 170, the combined steel sheet pile connection jig 100 can be reused over a long period of time.

[0062]

In the operation of FIG. 13D, in a case where the combined steel sheet pile 1 driven first does not reach a target driving depth, the height position of the upper end of the steel sheet pile 10 is higher than a typical position. Even in this case, since the notch 130 is provided in the end portion of the abutting portion 116 of the combined steel sheet pile connection jig 100, interference between the fitting portion 14 of the combined steel sheet pile 1 and the combined steel sheet pile connection jig 100 can be avoided when the combined steel sheet pile connection jig 100 is attached to the combined steel sheet pile 1X.

[0063]

According to this embodiment described above, since the combined steel sheet pile connection jig 100 having the guide portion 114 with the same shape as that of the fitting portion 14 of the steel sheet pile 10 can be attached to the combined steel sheet pile 1 so as to allow the guide portion 114 to overlap the fitting portion 14 of the steel sheet pile 10, the fitting portion 14 of the steel sheet pile 10 can be elongated in the Y direction. As a result, a plurality of combined steel sheet piles 1 do not need to be driven in two stages, and thus the operation of connecting the combined steel sheet piles can be efficiently performed.

[0064]

[Modification Example of Combined Steel Sheet Pile Connection Jig]

FIGS. 14A and 14B show a modification example of the combined steel sheet pile connection jig 100 according to this embodiment. FIG. 14A is a front view, and FIG. 14B is a cross-sectional view taken along line F-F of FIG. 14A. As shown in FIGS. 14A and 14B, the pair of fourth guide plates 121 are provided with, for example,

six stiffening plates 180 fixed to surfaces that face the guide surfaces 121a by welding or the like. In this structure, when the fitting portion 14 of the combined steel sheet pile 1X is allowed to abut the abutting surface 120a (see FIG. 11), the fourth guide plate 121 can be supported by the stiffening plate 180. Therefore, the stiffness of the fourth guide plate 121 can be enhanced.

[0065]

In addition, for example, as shown in FIG. 15, an H-shaped reinforcing member 190 having a pair of third guide plates 170 may be provided on the rear side of the web portion 111 of the jig 110. In this case, when the combined steel sheet pile connection jig 100 is attached to the combined steel sheet pile 1, the third guide plate 170 of the reinforcing member 190 may pinch the H-section steel 20 of the combined steel sheet pile 1. As a result, the stability of the jig 110 against loads in the X and Y directions during the connection operation can be enhanced. The reinforcing member 190 may be H-section steel manufactured by hot rolling or H-section steel manufactured by welding.

[0066]

In addition, for example, as shown in FIG. 16, a plate-like reinforcing member 192 having a pair of third guide plates 170 may be provided on the rear side of the web portion 111 of the jig 110. The reinforcing member 192 may be fixed to the web portion 111 of the jig 110 by welding or may be mechanically joined thereto with bolts using an L-shaped angle material (not shown).

[0067]

(Second Embodiment)

Next, a combined steel sheet pile connection jig 200 according to a second embodiment of the present invention will be described. Like elements which are similar to the above-described elements are denoted by like reference numerals, and overlapping description will be omitted in the following description.

[0068]

FIG. 17 is a front view showing the combined steel sheet pile connection jig 200 according to this embodiment. In the first embodiment, the case where the first guide plates 150, the second guide plate 160, and the third guide plates 170 protrude downward in the Y direction from the lower end 116a of the abutting portion 116 to the same length is described. Contrary to this, in the combined steel sheet pile connection jig 200 according to this embodiment, as shown in FIG. 17, the protruding length of the first guide plate 150 is longer than the protruding lengths of the second guide plate 160 and the third guide plates 170. Therefore, when the combined steel sheet pile

connection jig 200 is attached to the combined steel sheet pile 1, the first guide plate 150 reaches the upper end 15a of the steel sheet pile 10 faster than the second guide plate 160 and the third guide plates 170.

[0069]

In the combined steel sheet pile connection jig 200 according to this embodiment, the first guide plate 150 is, for example, a steel sheet having a width of 50 mm, a sheet thickness of 9 mm, and an overall length of 300 mm. In addition, a portion of the first guide plate 150 is fixed to the abutting portion 116, and the length of the portion is 100 mm. Furthermore, a portion of the first guide plate 150 protrudes from the lower end 116a of the abutting portion 116, and the length of the portion is 200 mm.

The second guide plate 160 and third guide plates 170 are, for example, steel sheets having a width of 50 mm, a sheet thickness of 9 mm, and an overall length of 200 mm. In addition, portions of the second and third guide plates 160 and 170 are fixed to the abutting portion 116, and the length of the portions is 100 mm. Furthermore, portions of the second and third guide plates 160 and 170 protrude from the lower end 116a of the abutting portion 116, and the length of the portions is 100 mm.

[0070]

Next, a method of attaching the combined steel sheet pile connection jig 200 to the combined steel sheet pile 1 will be described. FIG. 18A is a partial enlarged front view showing a state in which the combined steel sheet pile connection jig 200 is lowered from the state shown in FIG. 17 and the pair of first guide plates 150 pinch the upper end portion 15 of the steel sheet pile 10. FIG. 18B is a cross-sectional view taken along line G-G of FIG. 18A. First, as shown in FIGS. 18A and 18B, the combined steel sheet pile connection jig 200 is lowered to allow the pair of first guide plates 150 to pinch the upper end portion 15 of the steel sheet pile 10. At this time, in the combined steel sheet pile connection jig 200, the first guide plates 150 reach the upper end 15a of the steel sheet pile 10 faster than the second guide plate 160 and the third guide plates 170. Therefore, when the first guide plates 150 pinch the upper end portion 15 of the steel sheet pile 10, the second guide plate 160 and the third guide plates 170 can be reliably prevented from coming into contact with the steel sheet pile 10. As a result, an operation of pinching the pair of first guide plates 150 can be easily performed.

[0071]

Thereafter, while the pair of first guide plates 150 pinch the steel sheet pile 10, the combined steel sheet pile connection jig 200 is moved in the X direction to a

position at which the second guide plate 160 does not come into contact with the steel sheet pile 10 when the combined steel sheet pile connection jig 200 is lowered (see FIG. 19A).

[0072]

Next, as shown in FIG. 19B, the combined steel sheet pile connection jig 200 is further lowered to a position at which the third guide plates 170 pinch the flange portions 12 and the web portion 11 of the steel sheet pile 10 and the lower end of the abutting portion 116 does not come into contact with the upper end of the steel sheet pile 10. Thereafter, until the second guide plate 160 abuts the steel sheet pile 10, the combined steel sheet pile connection jig 200 is moved in the X direction.

[0073]

Next, as shown in FIG. 19C, the combined steel sheet pile connection jig 200 is moved downward in the Y direction until the lower end of the abutting portion 116 abuts the upper end of the steel sheet pile 10. Thereafter, as in the first embodiment, the combined steel sheet pile connection jig 200 is fixed to the steel sheet pile 10 by spot welding, fillet welding, or the like. Accordingly, the operation of attaching the combined steel sheet pile connection jig 200 is completed. Subsequent operations are the same as those of the first embodiment, and thus description thereof will be omitted.

[0074]

In a case where a convex portion 16 is provided in the fitting portion 14 of the steel sheet pile 10 in advance (see FIG. 18B), positioning of the guide portion 114 in the X direction with respect to the fitting portion 14 may be performed by using the convex portion 16. In this case, by providing the pair of first guide plates 150 at positions corresponding to the convex portion 16, the first guide plates 150 can be positioned in the Z direction and can be positioned in the X direction. That is, by moving the combined steel sheet pile connection jig 200 in the X direction until the first guide plates 150 reach the convex portion 16 in a state in which the pair of first guide plates 150 pinch the steel sheet pile 10, positioning of the guide portion 114 in the X and Y directions with respect to the fitting portion 14 can be performed. Therefore, the operation of attaching the combined steel sheet pile connection jig 200 can be more efficiently performed.

[0075]

(Third Embodiment)

Next, a combined steel sheet pile connection jig 300 according to a third embodiment of the present invention will be described. Like elements which are similar to the above-described elements are denoted by like reference numerals, and

overlapping description will be omitted in the following description.

[0076]

FIG. 20 is a front view showing the combined steel sheet pile connection jig 300 according to this embodiment. As shown in FIG. 20, in the combined steel sheet pile connection jig 300 according to this embodiment, the protruding length of the second guide plate 160 is longer than the protruding length of the first guide plate 150, and the protruding length of the first guide plate 150 is longer than the protruding length of the third guide plate 170. Therefore, when the combined steel sheet pile connection jig 300 is attached to the combined steel sheet pile 1, the second guide plate 160, the first guide plates 150, and the third guide plates 170 reach the upper end 15a of the steel sheet pile 10 in the order of the second guide plate 160, the first guide plates 150, and the third guide plates 170.

[0077]

The first guide plate 150 of the combined steel sheet pile connection jig 300 is, for example, a steel sheet having a width of 50 mm, a sheet thickness of 9 mm, and an overall length of 300 mm. In addition, a portion of the first guide plate 150 is fixed to the abutting portion 116, and the length of the portion is 100 mm. Furthermore, a portion of the first guide plate 150 protrudes from the lower end 116a of the abutting portion 116, and the length of the portion is 200 mm.

The second guide plate 160 of the combined steel sheet pile connection jig 300 is, for example, a steel sheet having a width of 50 mm, a sheet thickness of 9 mm, and an overall length of 400 mm. In addition, a portion of the second guide plate 160 is fixed to the abutting portion 116, and the length of the portions is 100 mm. Furthermore, a portion of the second guide plate 160 protrudes from the lower end 116a of the abutting portion 116, and the length of the portion is 300 mm.

The third guide plate 170 of the combined steel sheet pile connection jig 300 is, for example, a steel sheet having a width of 50 mm, a sheet thickness of 9 mm, and an overall length of 200 mm. In addition, a portion of the third guide plate 170 is fixed to the abutting portion 116, and the length of the portions is 100 mm. Furthermore, a portion of the third guide plate 170 protrudes from the lower end 116a of the abutting portion 116, and the length of the portion is 100 mm.

[0078]

Next, a method of attaching the combined steel sheet pile connection jig 300 according to this embodiment to the combined steel sheet pile 1 will be described. First, the combined steel sheet pile connection jig 300 is lowered from the state shown in FIG. 20 to a position at which the second guide plate 160 does not come into contact

with the upper end 15a of the steel sheet pile 10. In addition, the combined steel sheet pile connection jig 300 is moved in the X direction to a position, at which the second guide plate 160 does not come into contact with the upper end 15a of the steel sheet pile 10 when the second guide plate 160 is moved downward in the Y direction, while being visually checked.

[0079]

Next, the combined steel sheet pile connection jig 300 is lowered to allow the first guide plates 150 to pinch the upper end portion 15 of the steel sheet pile 10. FIG. 21A is a partial enlarged front view showing a state in which the pair of first guide plates 150 pinch the upper end portion 15 of the steel sheet pile 10. In addition, FIG. 21B is a cross-sectional view taken along line H-H of FIG. 21A. Thereafter, the combined steel sheet pile connection jig 300 is moved in the X direction while the pair of first guide plates 150 pinch the upper end portion 15 of the steel sheet pile 10 until the second guide plate 160 abuts the steel sheet pile 10. In addition, the combined steel sheet pile connection jig 300 is moved downward in the Y direction until the lower end 116a of the abutting portion 116 abuts the upper end 15a of the steel sheet pile 10. In the above-described operations, the combined steel sheet pile connection jig 300 can be attached to the combined steel sheet pile 1 so that the fitting portion 14 and the guide portion 114 overlap each other in a case of being viewed in the Y direction. Subsequent operations are the same as those of the first embodiment, and thus detailed description thereof will be omitted.

[0080]

As described above, in the connection method using the combined steel sheet pile connection jig 300, before the pair of first guide plates 150 pinch the upper end portion 15 of the steel sheet pile 10, the combined steel sheet pile connection jig 300 can be disposed in advance at a position at which the second guide plate 160 does not come into contact with the steel sheet pile 10. Therefore, the second guide plate 160 and the third guide plates 170 can be prevented from coming into contact with the steel sheet pile 10 when the first guide plates 150 pinch the steel sheet pile 10. Therefore, the operation of allowing the pair of first guide plates 150 to pinch steel sheet pile 10 can be smoothly performed, and the operation of attaching the combined steel sheet pile connection jig 300 can be efficiently performed.

[0081]

While each of the embodiment of the present invention have been described, these embodiments have been presented by way of example only, and the scope of the present invention is not limited only to these embodiments. These embodiments can

be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes may be made without departing from the spirit of the inventions. The inventions described in the accompanying claims and their equivalents are intended to cover the embodiments and such modifications as would fall within the scope and spirit of the inventions.

[0082]

For example, in the first embodiment, the case where the planar shape of the jig 110 of the combined steel sheet pile connection jig 100 is the same as the shape of the steel sheet pile 10 used in the combined steel sheet pile 1 is shown. However, from the viewpoint of an increase in the length of the fitting portion 14 of the steel sheet pile 10, at least the guide portion 114 of the jig 110 may have the same shape as that of the fitting portion 14 of the steel sheet pile 10.

[0083]

In addition, for example, in the first embodiment described above, the case where the combined steel sheet pile connection jig 100 is attached to the combined steel sheet pile 1 constituted by the hat-shaped steel sheet pile 10 and the H-section steel 20. However, the hat-shaped steel sheet pile 10 used in the combined steel sheet pile 1 may be a hat-shaped steel sheet pile which is integrally formed through a hot rolling or cold forming process, or a hat-shaped steel sheet pile constituted by two Z-section steel sheet piles manufactured through a hot rolling or cold forming process. In addition, according to the hat-shaped steel sheet pile 10 of the combined steel sheet pile 1, in the combined steel sheet pile connection jig 100, a hat-shaped steel sheet pile which is integrally formed through a hot rolling or cold forming process may be used as the jig 110, or a hat-shaped steel sheet pile constituted by two Z-section steel sheet piles manufactured through a hot rolling or cold forming process may be used as the jig 110. Furthermore, the main structural member is not limited to the H-section steel 20 and may also be T-section steel.

[Industrial Applicability]

[0084]

According to the present invention, a combined steel sheet pile connection jig and a combined steel sheet pile connection method in which efficiency improvement in an operation of connecting a plurality of combined steel sheet piles can be achieved can be provided.

[Brief Description of the Reference Symbols]

[0085]

1: COMBINED STEEL SHEET PILE

- 5: CONTINUOUS WALL
- 10: HAT-SHAPED STEEL SHEET PILE (STEEL SHEET PILE)
- 11: WEB PORTION OF HAT-SHAPED STEEL SHEET PILE
- 12: FLANGE PORTION OF HAT-SHAPED STEEL SHEET PILE
- 13: ARM PORTION OF HAT-SHAPED STEEL SHEET PILE
- 14: FITTING PORTION (JOINT PORTION) OF HAT-SHAPED STEEL SHEET PILE
- 15: UPPER END PORTION OF HAT-SHAPED STEEL SHEET PILE
- 16: CONVEX PORTION OF HAT-SHAPED STEEL SHEET PILE
- 20: H-SECTION STEEL
- 21: FLANGE PORTION OF H-SECTION STEEL
- 22: WEB PORTION OF H-SECTION STEEL
- 40: GUIDE FRAME
- 50: SPACER
- 60: SCAFFOLD
- 100: COMBINED STEEL SHEET PILE CONNECTION JIG (FIRST EMBODIMENT)
- 110: JIG OF COMBINED STEEL SHEET PILE CONNECTION JIG
- 111: WEB PORTION OF COMBINED STEEL SHEET PILE CONNECTION JIG
- 112: FLANGE PORTION OF COMBINED STEEL SHEET PILE CONNECTION JIG
- 113: ARM PORTION OF COMBINED STEEL SHEET PILE CONNECTION JIG
- 114: GUIDE PORTION OF COMBINED STEEL SHEET PILE CONNECTION JIG
- 116: ABUTTING PORTION (LOWER END PORTION OF JIG) OF COMBINED STEEL SHEET PILE CONNECTION JIG
- 116a: LOWER END (LOWER EDGE) OF ABUTTING PORTION
- 120: NOTCH (FIRST NOTCH)
- 120a: ABUTTING SURFACE
- 121: FOURTH GUIDE PLATE
- 121a: GUIDE SURFACE OF FOURTH GUIDE PLATE
- 123: WELD PORTION
- 130: NOTCH (SECOND NOTCH)
- 150: PAIR OF FIRST GUIDE PLATES (FIRST POSITIONING

PORTIONS)

160: SECOND GUIDE PLATE (SECOND POSITIONING PORTION)

170: THREE THIRD GUIDE PLATES (THIRD POSITIONING

PORTIONS)

172: WELD PORTION (FIXED PORTION)

180: STIFFENING PLATE

190: H-SHAPED REINFORCING MEMBER

192: PLATE-LIKE REINFORCING MEMBER

200: COMBINED STEEL SHEET PILE CONNECTION JIG (SECOND

EMBODIMENT)

300: COMBINED STEEL SHEET PILE CONNECTION JIG (THIRD

EMBODIMENT)

X: WALL STRUCTURE DIRECTION (WIDTH DIRECTION,
ARRANGEMENT DIRECTION OF ARM PORTIONS OF COMBINED STEEL
SHEET PILE)

Y: HEIGHT DIRECTION (VERTICAL DIRECTION)

Z: DIRECTION PERPENDICULAR TO WALL STRUCTURE
DIRECTION

[Document Type]

CLAIMS

1. A combined steel sheet pile connection jig which is used by being attached to an upper edge of a combined steel sheet pile when a plurality of combined steel sheet piles, each of which including a pair of parallel arm portions and fitting portions respectively provided for the arm portions, are connected to one another by connecting the fitting portions, the jig comprising:
 - a guide portion having the same shape as that of the fitting portion;
 - a first positioning portion which comes into sliding contact with the pair of arm portions along an arrangement direction of the pair of arm portions;
 - a second positioning portion which restricts further movement of the guide portion when the guide portion is moved along the arrangement direction and is aligned at a position relative to the fitting portion; and
 - an abutting portion which abuts the upper edge.
2. The combined steel sheet pile connection jig according to claim 1, further comprising:
 - a first notch which is provided in an upper end portion of the guide portion and has an abutting surface that abuts the fitting portion.
3. The combined steel sheet pile connection jig according to claim 2,
 - wherein the first notch further includes a pair of guide surfaces which allow the abutting surface to be interposed therebetween, and spread out from the abutting surface.
4. The combined steel sheet pile connection jig according to any one of claims 1 to 3,
 - wherein an end portion of the abutting portion includes a second notch.
5. The combined steel sheet pile connection jig according to any one of claims 1 to 4,
 - wherein the first positioning portion and the second positioning portion protrude downward in a vertical direction from a lower edge of the abutting portion, and
 - a protruding length of the first positioning portion is longer than a protruding length of the second positioning portion.
6. The combined steel sheet pile connection jig according to any one of claims 1 to 4,
 - wherein the first positioning portion and the second positioning portion

protrude downward in a vertical direction from a lower edge of the abutting portion, and
a protruding length of the first positioning portion is shorter than a protruding length of the second positioning portion.

7. The combined steel sheet pile connection jig according to any one of claims 1 to 6, further comprising:

a fixed portion fixed to the combined steel sheet pile.

8. A method of connecting a plurality of combined steel sheet piles using the combined steel sheet pile connection jig according to any one of claims 1 to 7, the method comprising:

a first driving process of driving the combined steel sheet pile;

a positioning process of moving the combined steel sheet pile connection jig until movement of the guide portion is restricted by the second positioning portion while the first positioning portion is allowed to come into sliding contact with the pair of arm portions of the combined steel sheet pile after the first driving process and thereafter allowing the abutting portion to abut the upper edge of the combined steel sheet pile; and

a second driving process of driving another combined steel sheet pile while fitting the fitting portion of the other combined steel sheet pile to the guide portion and subsequently to the fitting portion of the other combined steel sheet pile after the positioning process.