

DESCRIPTION

[Title of Invention] STEEL SHEET PILE AND STEEL SHEET PILE
WALL FORMED OF SUCH STEEL SHEET PILES

[Technical Field]

[0001]

The present invention relates to a steel sheet pile and
a steel sheet pile wall formed of such steel sheet piles.

[Background Art]

[0002]

A general U-shaped steel sheet pile has interlocking
joint portions at both ends thereof. Such U-shaped steel
sheet piles are driven in one at a time, with the
interlocking joint portions at both ends thereof interlocked,
to form a steel sheet pile wall. It is known that, in this
case, when a load acts on the steel sheet pile wall, the
neutral axis changes due to the displacement of the
interlocking joint portions, and the section rigidity and
section proof stress decrease.

[0003]

As a method to improve this, there is a method in which
two steel sheet piles are interlocked previously, are
connected and fixed to each other by crimping (application
of pressure), welding, or the like, and are driven in as a
unit formed of two steel sheet piles.

In this case, when conventional U-shaped steel sheet

piles are used, each steel sheet pile needs to be inserted the end in the longitudinal direction of the steel sheet pile first, in order to connect the joint portions, the work is not performed smoothly, and therefore this leads to a decrease in the efficiency of manufacturing and/or cost increase.

[0004]

As a method to improve this, in Patent Literature 1, there is proposed "A steel sheet pile in the shape of a U-shaped steel sheet pile including a web portion and flange portions placed at both ends thereof, wherein only one of the flange portions has an interlocking joint for connecting with another steel sheet pile, the other flange portion does not have an interlocking joint, and the end of the flange portion that does not have an interlocking joint is placed on a straight line extending from the corner where the web portion and the flange portion intersect each other, through the center of interlocking joint of the flange portion that has an interlocking joint, and parallel to the web portion, or is placed so as to straddle the straight line."

[Citation List]

[Patent Literature]

[0005]

Patent Literature 1: Japanese Unexamined Patent
Application Publication No. 2008-121279

[Summary of Invention]

[Technical Problem]

[0006]

In the steel sheet pile described in Patent Literature 1, the interlocking joint is formed at the end of the flange so as to be bent parallel to the web. On the side that does not have an interlocking joint, the flange portion is not bent and appears as if it is cut.

Therefore, the side that has an interlocking joint and the side that does not have an interlocking joint portion differ in length and angle, and the left-right asymmetry is high.

When one tries to manufacture a steel sheet pile having such a shape by roll forming, defects such as warpage, bending, and the like of the shape of the entire sheet pile are likely to occur because in the roll forming process, the rolling forces acting on both joint portions differ.

Therefore, it is very difficult to form a steel sheet pile having such a shape by roll forming, and the forming method is limited.

[0007]

When two steel sheet piles are connected together, the two steel sheet piles are assembled temporarily and placed horizontally with the flange portions that do not have an interlocking joint superimposed on each other, and then the

superimposed portions are connected and fixed to each other by crimping, with an adhesive, or the like.

In this case, the connecting and fixing direction is oblique to a straight line parallel to the web portion (horizontal direction), and therefore the loading direction in which crimping is performed or the pressure application direction when bonding is performed needs to be diagonal. Therefore, a device to perform loading or bonding with the direction of connecting and fixing of the steel sheet piles oblique to the web portion is needed, and there is a concern that the degree of difficulty of manufacture increases significantly.

[0008]

The present invention is made to solve such problems, and it is an object of the present invention to obtain such a steel sheet pile that it is suitable for manufacturing by roll forming and that two such steel sheet piles can be easily connected together, and a steel sheet pile wall formed of such steel sheet piles.

[Solution to Problem]

[0009]

(1) A steel sheet pile according to the present invention is a U-shaped steel sheet pile including a web portion, flange portions at both ends of the web portion, an interlocking joint portion formed at the end of one of the

flanges, and a joining portion formed at the end of the other flange and used for connecting with an adjacent U-shaped steel sheet pile, wherein the joining portion is a flat plate shape formed by bending the end of the flange portion parallel to the web portion and extending parallel to the web portion, and the position of the joining portion in a direction perpendicular to the web portion is set within the range of the height of the interlocking joint portion.

[0010]

(2) In the steel sheet pile according to (1), the flange-side surface of the joining portion is located on a straight line that passes through the center of the interlocking joint portion and that is parallel to the web portion.

[0011]

(3) In the steel sheet pile according to (1) or (2), a recess and a protrusion are provided on the flange-side surface of the joining portion.

[0012]

(4) In the steel sheet pile according to any one of Claims (1) to (3), the steel sheet pile is manufactured by roll forming.

[0013]

(5) A steel sheet pile wall according to the present

invention is formed by connecting two steel sheet piles according to any one of (1) to (4) together such that the flange side surfaces in the joining portions are in contact with each other and superimposed on each other, and driving the steel sheet piles connected together into the ground.

[Advantageous Effects of Invention]

[0014]

A steel sheet pile according to the present invention includes an interlocking joint portion formed at the end of one of the flanges, and a joining portion formed at the end of the other flange and used for connecting with an adjacent U-shaped steel sheet pile. The joining portion is a flat plate shape formed by bending the end of the flange portion parallel to the web portion and extending parallel to the web portion, and the position of the joining portion in a direction perpendicular to the web portion is set within the range of the height of the interlocking joint portion. Therefore, the steel sheet pile according to the present invention has a cross-section close to a left-right symmetrical shape. Therefore, when it is roll-formed, the rolling force in both joint portions is uniform, and the occurrence of defects such as warpage, bending, and the like of the shape of the entire sheet pile can be reduced significantly. Therefore, it is suitable for manufacturing by roll forming.

When the joining portions of two steel sheet piles are superimposed on each other and joined to each other, the loading direction in which crimping is performed or the pressure application direction when bonding is performed is perpendicular to the straight line (horizontal direction) parallel to the web portion, and therefore the connecting and fixing are easy.

[Brief Description of Drawings]

[0015]

[Fig. 1] Fig. 1 is an explanatory view showing the cross-sectional shape of a steel sheet pile according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is an explanatory view of an example when two steel sheet piles according to an embodiment of the present invention are connected together.

[Fig. 3] Fig. 3 is a detailed explanatory view of a joining portion of a steel sheet pile according to an embodiment of the present invention.

[Fig. 4] Fig. 4 is a detailed explanatory view of another example of a joining portion of a steel sheet pile according to an embodiment of the present invention.

[Fig. 5] Fig. 5 is a detailed explanatory view of another example of a joining portion of a steel sheet pile according to an embodiment of the present invention.

[Description of Embodiments]

[0016]

A steel sheet pile 1 according to this embodiment is a U-shaped steel sheet pile having a web portion 3 and flange portions 5 at both ends of the web portion 3, and it has an interlocking joint portion 7 formed at the end of one of the flange portions 5, and a flat plate-shaped joining portion 9 formed at the end of the other flange portion 5 and used for joining to another U-shaped steel sheet pile.

Each portion will be described in detail below.

[0017]

<Interlocking joint portion>

The interlocking joint portion 7 is a Larssen-type interlocking joint portion in which as shown in Fig. 1, the end of the flange portion 5 is bent outwardly and parallel to the web portion 3, and that has a claw portion 7a at the end thereof.

Although the interlocking joint portion shown in Fig. 1 is a Larssen-type interlocking joint portion, the interlocking joint portion 7 of the steel sheet pile 1 of the present invention is not limited to this, and may be, for example, a Lackawanna-type interlocking joint portion.

In Fig. 1, the width of the interlocking joint portion 7 is denoted by X, the height of the interlocking joint portion 7 is denoted by Y, and the center of the interlocking joint portion 7 is denoted by P.

[0018]

<Joining portion>

The joining portion 9 is a portion formed by bending the end of the flange portion 5 outwardly and parallel to the web portion 3, and formed into a flat plate shape extending parallel to the web portion 3.

As shown in Fig. 1, the joining portion 9 is configured such that the flange side surface 9a in the joining portion 9 is located on a straight line 11 that passes through the center P of the interlocking joint portion 7 and that is parallel to the web portion 3.

Since the joining portion 9 is configured in this manner, the left-right symmetry is high, and the shape is suitable for manufacturing by rolling.

In addition, since the joining portion 9 is configured as described above, as shown in Fig. 2, when two steel sheet piles 1 are superimposed on each other and joined to each other such that the flange side surfaces 9a in the joining portions 9 are in contact with each other, the two steel sheet piles 1 are connected together line-symmetrically with respect to the straight line 11. Therefore, the driving in of the two steel sheet piles 1 connected together is easy. Two steel sheet piles 1 connected together such as those shown in Fig. 2 will hereinafter be referred to as "a combined steel sheet pile."

[0019]

Although, in the above example, the flange side surface 9a is located on a straight line 11 that passes through the center P of the interlocking joint portion 7 and that is parallel to the web portion 3, the position of the joining portion 9 relative to the interlocking joint portion 7 of the present invention is not limited to this as long as the position of the flange side surface 9a in the joining portion 9 is within the range of the height Y of the interlocking joint portion 7. More specifically, "the position of the flange side surface 9a in the joining portion 9 is within the range of the height Y of the interlocking joint portion 7" means that in the cross-section shown in Fig. 1, when two straight lines in contact with the upper and lower surfaces of the interlocking joint portion 7 and parallel to the web portion 3 are extended to the joining portion 9 side, the flange side surface 9a is located between the two extended lines.

In such a case, the workability in the manufacturing by rolling, and the driving in of two steel sheet piles 1 connected together is within the acceptable range.

[0020]

The width W of the joining portion 9 is preferably 0.5X to 1.5X and more preferably 0.8X to 1.2X, where X is the width of the interlocking joint portion 7.

The reason that the width W of the joining portion 9 is in the above range is to adjust the left-right balance of the steel sheet pile 1, to reliably perform connection, and to prevent a needless increase in steel weight.

If the width W of the joining portion 9 is less than $0.5X$, it is difficult to reliably join two steel sheet piles 1, the left-right balance is disrupted at the time of rolling manufacturing, and manufacturing defects occur.

If the width W of the joining portion 9 is more than $1.5X$, the left-right balance is disrupted, and manufacturing defects may occur easily. Since the connecting portion is located in the center of a wall body formed by connecting two steel sheet piles 1 together, the connecting portion does not contribute to bending moment acting on the section of the steel sheet pile wall. Therefore, the increase in the length of the width W of the joining portion 9 decreases the proof stress and rigidity per unit length, and is undesirable.

[0021]

It is preferable to provide a protrusion 13 and a recess 15 for positioning, such as those shown in Fig. 3, on and in the flange side surface 9a in the joining portion 9.

Providing a recess and a protrusion such as those shown in Fig. 3 facilitates positioning. In addition, when crimping is performed, connecting and fixing can be

performed more firmly.

When two steel sheet piles 1 are connected together, and when the joining portions 9 are connected and fixed to each other by crimping, it is preferable to set the height of the protrusion 13 higher than the depth of the recess 15 of the other steel sheet pile. This can strengthen the connection by crimping.

The recess and protrusion for positioning may have a step shape as shown in Figs. 4 and 5. The joining portion 9 of the steel sheet pile 1 shown in Fig. 4 is joined to the joining portion 9 of the steel sheet pile 1 shown in Fig. 5. The recess 15 of the joining portion 9 in the steel sheet pile 1 of Fig. 5 is placed at the position of the protrusion 13 of the joining portion 9 in the steel sheet pile 1 of Fig. 4, and the protrusion 13 of the joining portion 9 in the steel sheet pile 1 of Fig. 5 is placed at the position of the recess 15 of the steel sheet pile 1 of Fig. 4.

[0022]

The steel sheet pile 1 configured as above has a shape suitable for forming by roll forming.

That is, since the steel sheet pile has the cross-sectional shape shown in Fig. 1, the ends of both flanges are about the same length and angle, and the cross-section is close to a left-right symmetrical shape. Therefore, in the roll forming process, the rolling force in both joint

portions is close to uniform, and the occurrence of defects such as warpage, bending, and the like of the shape of the entire sheet pile can be reduced significantly.

The conventional steel sheet pile 1 having interlocking joint portions 7 on both sides thereof is manufactured in rolling equipment. The steel sheet pile 1 of this embodiment can be manufactured by utilizing existing rolling equipment for a steel sheet pile used for manufacturing such a conventional steel sheet pile 1, and the manufacturing cost can be reduced.

[0023]

As shown in Fig. 2, two steel sheet piles 1 configured as above are brought into contact with each other and connected to each other such that the flange side surfaces 9a in the joining portions 9 are superimposed on each other. When the two steel sheet piles are connected together, the two steel sheet piles 1 are assembled temporarily and placed horizontally with the joining portions 9 superimposed on each other, and then connecting and fixing are performed by crimping, with an adhesive, or the like. At this time, the loading direction in which crimping is performed or the pressure application direction when bonding is performed is perpendicular to the straight line 11 (horizontal direction) parallel to the web portion 3, and therefore the connecting and fixing are easy.

When two steel sheet piles 1 are connected and fixed to each other, crimping may be performed throughout the length of the steel sheet piles, or crimping may be performed, for example, at a 1 m pitch or a 3 m pitch in accordance with the shear force in the connecting portion.

[0024]

A combined steel sheet pile formed of two steel sheet piles 1 connected together is driven into the ground with a vibrohammer or the like.

As shown in Fig. 2, the connecting portion extends parallel to the web portion 3, therefore unlike Patent Literature 1, the entire width does not decrease, and therefore it is not necessary to increase the width using another member.

After a combined steel sheet pile is driven in, another combined steel sheet pile is driven in next to it such that the interlocking joint portions 7 are interlocked. By performing this continuously, a steel sheet pile wall is formed.

[0025]

In the above embodiment, the joining portions 9 are connected and fixed to each other by crimping or with an adhesive. Alternatively, bolt holes may be provided in the joining portions 9 previously, and the joining portions 9 may be joined with bolts.

The length and width of the steel sheet pile 1 that is the basic shape of the U-shaped steel sheet pile of the present invention are not particularly limited, and the U-shaped steel sheet pile of the present invention can be applied to steel sheet piles having the same basic shapes as conventional steel sheet piles having various shapes.

[Reference Signs List]

[0026]

- 1 steel sheet pile
- 3 web portion
- 5 flange portion
- 7 interlocking joint portion
- 7a claw portion
- 9 joining portion
- 9a flange side surface
- 11 straight line
- 13 protrusion
- 15 recess

CLAIMS

[Claim 1]

A steel sheet pile in the shape of a U-shaped steel sheet pile comprising:

a web portion;

flange portions at both ends of the web portion;

an interlocking joint portion formed at the end of one of the flanges; and

a joining portion formed at the end of the other flange and used for connecting with an adjacent U-shaped steel sheet pile,

wherein the joining portion is a flat plate shape formed by bending the end of the flange portion parallel to the web portion and extending parallel to the web portion, and the position of the joining portion in a direction perpendicular to the web portion is set within the range of the height of the interlocking joint portion.

[Claim 2]

The steel sheet pile according to Claim 1, wherein the flange-side surface of the joining portion is located on a straight line that passes through the center of the interlocking joint portion and that is parallel to the web portion.

[Claim 3]

The steel sheet pile according to Claim 1 or 2, wherein

a recess and a protrusion are provided on the flange-side surface of the joining portion.

[Claim 4]

The steel sheet pile according to any one of Claims 1 to 3, wherein the steel sheet pile is manufactured by roll forming.

[Claim 5]

A steel sheet pile wall formed by connecting two steel sheet piles according to any one of Claims 1 to 4 together such that the flange side surfaces in the joining portions are in contact with each other and superimposed on each other, and driving the steel sheet piles connected together into the ground.