

Description

Title of Invention: NON-WELDED JOINT FOR PILES

Technical Field

[0001] The present invention relates to a weldless joint for piles, which is configured to connect, without welding, piles to be axially joined to each other when precast concrete piles or other types of piles are driven into the ground.

Background Art

[0002] In general, when prefabricated piles are driven into the ground, there has been employed a method of driving, into a desired depth, precast concrete piles each having a predetermined length while connecting the precast concrete piles together in a length direction as needed. In this case, the piles are connected by a method of connecting, by welding, metal end plates arranged integrally with end surfaces of the precast concrete piles, respectively.

[0003] However, in the connecting method using the welding, connection strength depends on whether or not satisfactory welding has been conducted. Therefore, high skill is required in the connecting method using the welding, but the number of experienced and skilled workers has become insufficient in recent years. Further, the pile connecting work is conducted outdoors at the site where piles are driven, thereby causing a problem in that the pile connecting

work depends on weathers.

[0004] Accordingly, in recent years, there has been developed a weldless joint that does not require the welding. As illustrated in FIG. 13, the related-art weldless joint includes arc-shaped plates 3 that are mounted over end fittings 2, 2 of piles 1, 1 to be connected to each other, and are fitted on outer peripheries of the end fittings 2, 2. The arc-shaped plates 3 each have a shape obtained by dividing a cylinder into multiple pieces in a radial direction. In addition, there has been developed such a method that flange-shaped protruding threads 5, 5 formed in a protruding manner on outer peripheral surfaces of the end fittings 2, 2 are fitted in a recessed groove 4 formed in an inner peripheral surface of each of the arc-shaped plates 3, to thereby fix the arc-shaped plates 3 to the end fittings 2, 2 with bolts 6 (for example, Patent Literature 1).

[0005] Further, the following method has been developed as the method of fixing the arc-shaped plates as described above. As illustrated in FIG. 14, arc-shaped-plate interconnecting protrusions 3a, 3a are formed on outer peripheries of end portions of each of the arc-shaped plates 3 that are mounted over the end fittings 2, 2 of the piles 1, 1. The arc-shaped-plate interconnecting protrusions 3a, 3a each have a shape obtained by vertically dividing a dovetail shape in half. In addition, there is used an arc-shaped-plate interconnecting fitting 7 having a plate-like shape with a tapered dovetail groove 7a to be fitted to the dovetail shape. The interconnecting protrusions 3a, 3a are fitted in the tapered

dovetail groove 7a, and the arc-shaped-plate interconnecting fitting 7 is slid, to thereby connect the arc-shaped plates 3, 3 together while bringing the arc-shaped plates 3, 3 close to each other (Patent Literature 2).

Citation List

Patent Literature

[0006] [PTL 1] JP 2003-82656 A

[PTL 2] JP 2011-89302 A

Summary of Invention

Technical Problems

[0007] In the related-art weldless joint for piles, the above-mentioned weldless joint having the structure as illustrated in FIG. 13 involves the fixing of the arc-shaped plates to the upper and lower end fittings with bolts, and hence a large number of bolts are used, thereby causing a problem in that the fixing work with bolts requires much time and effort.

[0008] Further, it is necessary to form a large number of screw holes in the end fittings of the piles in advance. In order to protect the screw holes, hole plugging bolts having square holes for fitting tools are mounted to end surfaces of the end fittings. In this state, concrete is placed and steam curing is performed after removal of the molds. However, the screw holes and the hole plugging bolts are placed in a severe environment, thereby causing a problem in

that some of the hole plugging bolts cannot be removed and the entire piles are therefore discarded inevitably.

[0009] In the method of connecting the arc-shaped plates by the arc-shaped-plate interconnecting fitting having a plate-like shape as illustrated in FIG. 14, there are problems in that, when significant bending moment acts on the joint part, the connecting fitting may be deformed, and that the shear strength of the connecting fitting in a direction orthogonal to an axial direction is smaller than that of a pile body.

[0010] Further, the connecting method has a problem in that torque transmission is unsatisfactory when the piles need to be driven while turning the piles.

[0011] The present invention has been made in view of the problems inherent in the related art, and has an object to provide a weldless joint for piles, which is capable of achieving reduction in number of members to be used, reduction in cost, satisfactory workability, and high flexural and shear strengths, and is also capable of providing a mechanism of transmitting rotational torque at the same time.

Solution to Problems

[0012] In order to solve the problems inherent in the related art as described above, the feature of the invention according to claim 1 resides in a weldless joint for piles, including: end fittings respectively arranged at joining end portions of piles to be connected

to each other; and a plurality of arc-shaped plates fitted over the end fittings so as to be arranged around outer peripheries of the end fittings, the end fittings including flange-shaped protruding threads formed integrally along the outer peripheries thereof, the plurality of arc-shaped plates including recessed grooves formed in inner peripheral surfaces thereof, the protruding threads of the end fittings being fitted in the recessed grooves, the piles being connected to each other by fitting the protruding threads in the recessed grooves so as to fit the plurality of arc-shaped plates on the outer peripheries of the end fittings.

The end fittings include shear ring fitting portions having a circular ring shape, respectively, the shear ring fitting portions being formed in joining surfaces of the end fittings, respectively, and being arranged coaxially with the end fittings. A shear ring having a circular ring shape is interposed astride the shear ring fitting portions in the joining surfaces. The shear ring fitting portions each include a projection formed on a bottom surface thereof by partially heightening the bottom surface. The shear ring integrally includes a recess in which the projection is fitted, the recess being formed in each of upper and lower surfaces of the shear ring at a position corresponding to the projection on the bottom surface. The projection on the bottom surface is fitted in the recess in the each of the upper and lower surfaces of the shear ring so that the shear ring and the end fittings are prevented from relatively moving in a circumferential direction, to thereby

transmit a moment of rotation between the piles to be connected upright.

[0013] In addition to the configuration according to claim 1, the feature of the invention according to claim 2 resides in that the weldless joint for piles further includes an arc-shaped-plate interconnecting fitting having a plate-like shape, the arc-shaped-plate interconnecting fitting being fixed over outer surfaces of end portions of adjacent arc-shaped plates of the plurality of arc-shaped plates, to thereby connect the plurality of arc-shaped plates together, that the arc-shaped-plate interconnecting fitting has a tapered dovetail groove formed therein, the tapered dovetail groove having a dovetail-groove-shaped cross-section and being formed into such a tapered shape that any one of upper and lower sides of the tapered dovetail groove is narrow, that the adjacent arc-shaped plates include arc-shaped-plate interconnecting protrusions formed on the outer surfaces of the end portions thereof, respectively, the arc-shaped-plate interconnecting protrusions each having a shape obtained by vertically dividing in half a tapered dovetail shape that is fitted to the tapered dovetail groove, that the arc-shaped-plate interconnecting protrusions are inserted into the tapered dovetail groove so that the arc-shaped-plate interconnecting fitting connects the adjacent arc-shaped plates together, and that end portions of the arc-shaped-plate interconnecting fitting are screwed onto the adjacent arc-shaped plates.

[0014] In addition to the configuration according to claim 1 or 2, the feature of the invention according to claim 3 resides in that the shear ring fitting portions are formed into a groove shape in surfaces of the joining surfaces of the end fittings, respectively.

[0015] In addition to the configuration according to claim 1 or 2, the feature of the invention according to claim 4 resides in that the shear ring fitting portions are each formed into an annular shape obtained by shaving, in a stepped manner, a corner defined by the joining end surface and an inner peripheral rim surface of an end plate center opening formed in a center of each of the end fittings, and that the shear ring having the circular ring shape is fitted on the inner peripheral surface of the end plate center opening.

[0016] In addition to the configuration according to claim 3 or 4, the feature of the invention according to claim 5 resides in that the shear ring fitting portions of the end fittings are each formed into such a tapered shape that the bottom surface side is narrower than a joining surface opening side, and that upper and lower sides of an inner peripheral surface of the shear ring and upper and lower sides of an outer peripheral surface of the shear ring are each formed into a tapered shape conforming to each of the shear ring fitting portions.

[0017] In addition to the configuration according to claim 1, the feature of the invention according to claim 6 resides in that

the shear ring is formed integrally with one of the end fittings in a protruding manner so as to have such a trapezoid cross-section that a protruding end portion side is narrow, and that the shear ring is fitted in the shear ring fitting portion that is formed in another one of the end fittings so as to have a shape conforming to the trapezoid shape of the shear ring formed integrally with the one of the end fittings.

Advantageous Effects of Invention

[0018] As described in claim 1, the weldless joint for piles according to the present invention includes: the end fittings respectively arranged at the joining end portions of the piles to be connected to each other; and the plurality of arc-shaped plates fitted over the end fittings so as to be arranged around the outer peripheries of the end fittings, the end fittings including the flange-shaped protruding threads formed integrally along the outer peripheries thereof, the plurality of arc-shaped plates including the recessed grooves formed in the inner peripheral surfaces thereof, the protruding threads of the end fittings being fitted in the recessed grooves, the piles being connected to each other by fitting the protruding threads in the recessed grooves so as to fit the plurality of arc-shaped plates on the outer peripheries of the end fittings.

The end fittings include the shear ring fitting portions having a circular ring shape, respectively, the shear ring fitting portions being formed in the joining surfaces of the end fittings, respectively,

and being arranged coaxially with the end fittings. The shear ring having a circular ring shape is interposed astride the shear ring fitting portions in the joining surfaces. The shear ring fitting portions each include the projection formed on the bottom surface thereof by partially heightening the bottom surface. The shear ring integrally includes the recess in which the projection is fitted, the recess being formed in each of the upper and lower surfaces of the shear ring at the position corresponding to the projection on the bottom surface. The projection on the bottom surface is fitted in the recess in each of the upper and lower surfaces of the shear ring so that the shear ring and the end fittings are prevented from relatively moving in the circumferential direction, to thereby transmit a moment of rotation between the piles to be connected upright. With this, the shear ring is interposed between the end fittings of the piles to be connected to each other, thereby increasing the shear strength in the direction orthogonal to the axial direction and the strength of the joint part.

[0019] In addition, the fitting of the recesses and the projections prevents the shear ring and the shear ring fitting portions from relatively moving in a rotational direction, thereby adding a torque transmitting function at the same time. As a result, multi-functional joint structure can be obtained with a smaller number of members.

[0020] As described in claim 2, the weldless joint for piles according to the present invention further includes the

arc-shaped-plate interconnecting fitting having a plate-like shape and being configured to connect the adjacent arc-shaped plates together. The arc-shaped-plate interconnecting fitting has the tapered dovetail groove formed therein, and the tapered dovetail groove has a dovetail-groove-shaped cross-section and formed into such a tapered shape that any one of the upper and lower sides of the tapered dovetail groove is narrow. The adjacent arc-shaped plates include the arc-shaped-plate interconnecting protrusions formed on the outer surfaces of the end portions thereof, respectively, and the arc-shaped-plate interconnecting protrusions each have a shape obtained by vertically dividing in half the tapered dovetail shape that is fitted to the tapered dovetail groove. The arc-shaped-plate interconnecting protrusions are inserted into the tapered dovetail groove so that the arc-shaped-plate interconnecting fitting connects the adjacent arc-shaped plates together. Accordingly, unlike the related art, it is unnecessary to perform fastening work on a large number of screws. Further, the members are lightweight, and hence the piles can be connected together in a short period of time with good workability.

[0021] Further, both ends of the arc-shaped-plate interconnecting fitting are screwed onto the arc-shaped plates. Thus, when a bending force is applied to a connecting portion between the piles, component forces of separating the arc-shaped plates from each other are generated, whereas a force of outwardly warping the both ends of the arc-shaped-plate interconnecting fitting is

applied to the arc-shaped-plate interconnecting fitting. However, the warpage at this time is prevented through the screwing, and hence it is unnecessary to increase flexural strength of the arc-shaped-plate interconnecting fitting. As a result, the arc-shaped-plate interconnecting fitting can be formed into a thin fitting that is lightweight and easy to handle, and is also reduced in protruding height from the outer peripheries of the piles.

[0022] As described in claim 3, according to the present invention, the shear ring fitting portions are formed into the groove shape in the surfaces of the joining surfaces of the end fittings, respectively. Accordingly, the shear ring fitting portions can be easily formed by machining the disc-like end fittings using a lathe, whereas the shear ring can be easily formed by machining a circular ring material using a lathe.

[0023] As described in claim 4, according to the present invention, the shear ring fitting portions are each formed into an annular shape obtained by shaving, in a stepped manner, the corner defined by the joining end surface and the inner peripheral rim surface of the end plate center opening formed in the center of each of the end fittings, and the shear ring having the circular ring shape is fitted on the inner peripheral surface of the end plate center opening. Accordingly, the shear ring fitting portions can be formed in the end fittings easily.

[0024] As described in claim 5, according to the present invention, the shear ring fitting portions of the end fittings are

each formed into such a tapered shape that the bottom surface side is narrower than the joining surface opening side, and the upper and lower sides of the inner peripheral surface of the shear ring and the upper and lower sides of the outer peripheral surface of the shear ring are each formed into a tapered shape conforming to each of the shear ring fitting portions. Accordingly, when joining the end fittings of the upper and lower piles together, owing to the tapered grooves of the end fittings and the tapered shape of the shear ring, the piles are aligned automatically, thereby facilitating high-precision joining of the piles.

[0025] As described in claim 6, according to the present invention, the shear ring is formed integrally with one of the end fittings in a protruding manner so as to have such a trapezoid cross-section that the protruding end portion side is narrow, and the shear ring is fitted in the shear ring fitting portion that is formed in another one of the end fittings so as to have a shape conforming to the trapezoid shape of the shear ring formed integrally with the one of the end fittings. Accordingly, the shear ring is formed together with the end fitting when forming the end fitting, thereby reducing the number of manufacturing steps, which leads to reduction in cost.

Brief Description of Drawings

[0026] FIG. 1 is a cross-sectional view illustrating an example of a weldless joint for piles according to the present invention.

FIG. 2 is a longitudinal sectional view illustrating the weldless joint for piles according to the present invention.

FIG. 3 is a perspective view illustrating an example of a shear ring employed in the present invention.

FIG. 4 is a cross-sectional view illustrating a structure for interconnecting arc-shaped plates of the weldless joint illustrated in FIG. 1.

FIG. 5 is a front view illustrating the structure for interconnecting the arc-shaped plates of the weldless joint.

FIGS. 6 are views illustrating one of the arc-shaped plates of the weldless joint illustrated in FIG. 1, in which FIG. 6(a) is a view illustrating an end surface of the arc-shaped plate, and FIG. 6(b) is a plan view illustrating an end portion of the arc-shaped plate.

FIGS. 7 are views illustrating an arc-shaped-plate interconnecting fitting of the weldless joint illustrated in FIG. 1, in which FIG. 7(a) is a front view illustrating the arc-shaped-plate interconnecting fitting, and FIG. 7(b) is a plan view illustrating the arc-shaped-plate interconnecting fitting.

FIG. 8 is a partial sectional view illustrating shear ring fitting portions and the shear ring portion in a pile joining process.

FIG. 9 is a partial sectional view illustrating another embodiment of the present invention.

FIG. 10 is a partial sectional view illustrating still another embodiment of the present invention.

FIG. 11 is a partial sectional view illustrating still another embodiment of the present invention.

FIG. 12 is a partial sectional view illustrating still another embodiment of the present invention.

FIG. 13 is a longitudinal sectional view illustrating an example of the related-art.

FIG. 14 is a partial perspective view illustrating another example of the related-art.

Description of Embodiments

[0027] Next, modes for carrying out the present invention are described with reference to embodiments illustrated in the drawings. The embodiments exemplify a case where a weldless joint for piles according to the present invention is employed to connect precast concrete piles together.

[0028] In the drawings, the pile includes a pile body 10, a steel pipe 11 that covers an outer periphery of the pile body 10, and an end fitting 12 arranged integrally with an end portion of the pile body 10.

[0029] The end fitting 12 is formed into a circular plate-like shape, and has an outer surface serving as a joining surface 12a. Although not shown, an end portion of a prestressed concrete (PC) tendon for introducing prestressing, which is inserted into the pile body 10, is fixed to the end fitting 12.

[0030] Shear ring fitting portions 30, 30 are respectively

formed in the upper and lower joining surfaces 12a, 12a so as to face each other in alignment. Each of the shear ring fitting portions 30, 30 is formed into a circular-ring-shaped recessed groove that is to be arranged coaxially with the end fitting 12. A circular-ring-shaped shear ring 31 is fitted in the shear ring fitting portions 30, 30 so as to be arranged astride the shear ring fitting portions 30, 30.

[0031] Each of the shear ring fitting portions 30, 30 is formed into such a trapezoid shape that a cross-section taken along a radial direction of a pile is narrower on a bottom surface side, i.e., on a groove bottom 30a side, and is wider on a groove opening side. A cross-section of the shear ring 31 taken along the radial direction of the pile is formed into such a shape that an upper normal trapezoid and a lower inverted trapezoid symmetrical with respect to a center in a height direction are integrally superposed in conformity with the shear ring fitting portions 30, 30, that is, a shape tapered upward and downward with respect to the center in the height direction.

[0032] Recesses 32, 32 are formed in each of upper and lower surfaces of the shear ring 31. The recesses 32, 32 are recessed by cutting out peripheral portions of the shear ring 31 at predetermined intervals. Projections 33, 33, which are fitted in the recesses 32, 32, are formed correspondingly to the recesses 32, 32 on a bottom of each of the shear ring fitting portions 30, 30 of the end fittings.

[0033] The projections 33 of the shear ring fitting portions

30, 30 of the end fittings 12, 12 are fitted in the recesses 32 of the shear ring 31 so that the end fittings 12, 12 are joined together while being prevented from moving relatively in a circumferential direction.

[0034] A protruding thread 13 protruding in a flange shape from an outer periphery of the steel pipe 11 is integrally formed along the outer periphery of the end fitting 12. Upper and lower piles 1, 1 are joined upright together. Thus, under a state in which the protruding threads 13, 13 formed along the outer peripheries of the both end fittings 12, 12 are superposed one on top of the other, the protruding threads 13, 13 protrude from an outer periphery of a joining section. Arc-shaped plates 15 are mounted onto the outer periphery of the joining section.

[0035] Each of the arc-shaped plates 15 has a shape obtained by dividing a cylindrical ring into three pieces in a circumferential direction. An inner peripheral surface of each of the arc-shaped plates 15 is formed into an arc-shape having substantially the same curvature as that of an outer peripheral surface of the end fitting 12. Each of the arc-shaped plates 15 is formed so as to have an arc-shape-direction length that enables formation of gaps 16 for absorbing an interference at the time of clamping described later when the three arc-shaped plates 15, 15, 15 are fitted on the outer peripheries of the end fittings 12.

[0036] A recessed groove 17 (illustrated in FIGS. 2 and 6) is formed in the inner peripheral surface of each of the arc-shaped

plates 15. When the end fittings 12, 12 of the piles 1, 1 to be connected to each other are joined together by arranging the joining surfaces 12a, 12a of the end fittings 12, 12 in a superposing manner, the protruding threads 13, 13 protruding from the outer periphery of the joining section are fitted in the recessed groove 17.

[0037] Flat surface portions 19, 19 (illustrated in FIGS. 4 and 6) are respectively formed on outer surfaces of end portions of the arc-shaped plates 15. The flat surface portions 19, 19 are in a flush arrangement on the outer peripheral surfaces of the end portions of the arc-shaped plates 15, 15 that are adjacent to each other under a state in which the adjacent arc-shaped plates 15, 15 are arranged and fitted around the outer peripheries of the end fittings 12, 12.

[0038] The flat surface portions 19, 19 are shaped by flattening and shaving the outer peripheral surfaces of the end portions of the arc-shaped plates 15, 15 while leaving arc-shaped-plate interconnecting protrusions 20, 20 described later.

[0039] The arc-shaped-plate interconnecting protrusions 20, 20 are brought close to each other and connected together by fixing with an arc-shaped-plate interconnecting fitting 21. Further, outer surfaces of the arc-shaped-plate interconnecting protrusions 20, 20 are formed into flat surfaces so as to be flush with each other.

[0040] Under a state in which end surfaces of the adjacent arc-shaped plates 15, 15 face each other, the arc-shaped-plate

interconnecting protrusions 20, 20 each have a vertically-tapered shape that becomes narrower toward its upper side, and a cross-section of each of the arc-shaped-plate interconnecting protrusions 20, 20 exhibits a halved shape obtained by vertically dividing in half a dovetail shape as illustrated in FIGS. 1 and 2.

[0041] In other words, a plate-end-side surface 20a of the arc-shaped-plate interconnecting protrusion 20 is parallel to an axis of the pile, and a plate-center-side surface 20b thereof is formed into such a tapered shape that its upper side is inclined toward a plate end side, and is also formed into such a dovetail shape that a protrusion surface side is wider than a plate surface side, i.e., than a protrusion root portion. With this configuration, a pair of the adjacent arc-shaped-plate interconnecting protrusions 20, 20 is formed into an upwardly-tapered shape so that tapered surfaces thereof exhibit a dovetail shape that becomes wider toward the protrusion surface side.

[0042] The entire arc-shaped-plate interconnecting fitting 21 is formed into a flat-plate-like shape, and a tapered dovetail groove 22 is formed in a back surface of the arc-shaped-plate interconnecting fitting 21. The above-mentioned pair of the arc-shaped-plate interconnecting protrusions 20, 20 exhibiting a tapered dovetail shape is fitted in the tapered dovetail groove 22. The arc-shaped-plate interconnecting fitting 21 is slid from an upper side of the arc-shaped-plate interconnecting protrusions 20, 20, and the arc-shaped-plate interconnecting protrusions 20, 20 are

inserted into the tapered dovetail groove 22. Thus, horizontal component forces generated on the tapered surfaces connect the both arc-shaped-plate interconnecting protrusions 20, 20 together while acting so as to bring the both arc-shaped-plate interconnecting protrusions 20, 20 close to each other.

[0043] The three arc-shaped-plate interconnecting fittings 21 connect together the end portions of the three arc-shaped plates 15 in a circular arrangement while bringing the three arc-shaped plates 15 close to each other. Thus, the three arc-shaped plates 15 are connected so as to form a cylindrical shape, to thereby connect the end fittings 12, 12 of the both piles together.

[0044] Bolt insertion holes 25 are formed in each end portion of the arc-shaped-plate interconnecting fitting 21 so as to pass through front and back surfaces thereof. Further, screw holes 26 are formed in the flat surface portion 19 of each end of the arc-shaped plate 15 at positions aligned with the above-mentioned bolt insertion holes 25 under a state in which the arc-shaped plates 15, 15 described above are brought close to each other and connected together. Sewing bolts 27 are inserted into the bolt insertion holes 25, and then screwed and clamped into the screw holes 26. Thus, the arc-shaped plates 15, 15 and the arc-shaped-plate interconnecting fitting 21 are fixed together.

[0045] Work of connecting the piles 1, 1 together by the weldless joint configured as described above is conducted in the following manner. Specifically, as illustrated in FIG. 8, the lower pile 1

is driven in advance, and the shear ring 31 having a ring shape is fitted in the shear ring fitting portion 30 formed in the joining surface 12a of the end fitting 12 arranged at an upper end of the lower pile 1.

At this time, under a state in which the projections 33 on the bottom of the shear ring fitting portion 30 of the lower end fitting 12 are fitted in the recesses 32 formed in a lower surface of the shear ring, an upper surface side of the shear ring 31 protrudes from the joining surface 12a.

[0046] Next, an upper side of the shear ring 31 is fitted in the shear ring fitting portion 30 of the upper joining surface 12a, and the joining surface 12a of the end fitting 12 at a lower end of the upper pile 1 is joined to the joining surface 12a of the end fitting 12 of the above-mentioned lower pile 1.

At this time, the shear ring fitting portion 30 has such a trapezoid shape that the bottom surface 30a side is narrow, that is, such a tapered shape that the joining surface opening side is wider than the bottom surface 30a, and the upper side of the shear ring 31 is formed into a tapered shape in conformity with the above-mentioned trapezoid or tapered shape. Accordingly, misalignment between the end fittings 12, 12 to be joined together is allowed by an amount equivalent to a dimensional difference between a joining surface opening width b1 of the shear ring fitting portion 30 and a tip width b2 of the shear ring 31.

After the shear ring fitting portion 30 of the upper end fitting

12 is inserted to an upper surface side of the shear ring 31 in this manner, the upper pile 1 is turned in its circumferential direction up to a position where the recesses 32 and the projections 33 are aligned. In this way, the recesses 32 and the projections 33 are fitted to each other so that the piles are joined together under a state in which the shear ring 31 is prevented from relatively moving in the circumferential direction thereof between the end fittings 12, 12.

Further, at the same time, the above-mentioned misalignment is corrected when joining the piles 1, 1 together. Thus, the piles 1, 1 are joined together while precise alignment is automatically conducted.

[0047] The piles 1, 1 are joined together in the above-mentioned manner, and thus the three arc-shaped plates 15, 15, 15 are fitted in a ring shape on the outer side of the protruding threads 13, 13 that are superposed along the outer periphery of the joining section to protrude in an annular shape. The arc-shaped-plate interconnecting fitting 21 is slid so as to fit the arc-shaped-plate interconnecting protrusions 20, 20 of the adjacent arc-shaped plates 15, 15 into the tapered dovetail groove 22 of the arc-shaped-plate interconnecting fitting 21, to thereby fix the arc-shaped plates 15, 15 by clamping while bringing the arc-shaped plates 15, 15 close to each other. The sliding operation of the arc-shaped-plate interconnecting fitting 21 is carried out using a hydraulic jack.

[0048] Next, the sewing bolts 27 are inserted into the bolt

insertion holes 25 of the arc-shaped-plate interconnecting fitting 21, and then screwed and clamped into the screw holes 26 of the arc-shaped plates 15, 15. Thus, the arc-shaped plates 15, 15 and the arc-shaped-plate interconnecting fitting 21 are fixed together.

[0049] In the above-mentioned example, the arc-shaped plates 15 are each formed into a shape obtained by dividing a cylindrical ring into three pieces in the circumferential direction, but may be formed into another shape obtained by dividing a cylindrical ring into multiple pieces in the circumferential direction.

[0050] Further, the shear ring fitting portion 30 is formed into such a tapered shape that an end plate center opening width side is wider than the bottom surface side. However, as illustrated in FIG. 9, the shear ring fitting portion 30 may be formed into such a shape that the end plate center opening width side has the same width as that of the bottom surface side, and that a cross-section of the shear ring fitting portion 30 taken along the radial direction of the pile is formed into a rectangular recessed groove, and a cross-section of the shear ring 31 taken along the same direction conforms to the cross-section of the shear ring fitting portion 30.

[0051] Still further, the above-mentioned example exemplifies a case where the shear ring fitting portion 30 is formed in a center of a radial width of the end fitting 12 having a disc ring shape (doughnut shape). In addition, as illustrated in FIG. 10, the shear ring fitting portion 30 may be formed into an annular shape obtained

by shaving, in a stepped manner, a corner defined by the joining end surface 12a and an inner peripheral surface 12b of the end plate center opening formed in a center of the end fitting 12, and the circular-ring-shaped shear ring 31 may be fitted and arranged so as to be exposed to the inner peripheral surface 12b of the end plate center opening.

[0052] Still further, the above-mentioned example exemplifies a case where the shear ring 31 is formed separately from the end fitting 12. However, as illustrated in FIGS. 11 and 12, such structure may be employed that the shear ring 31 is formed integrally with one of the end fittings 12 and the shear ring fitting portion 30 is formed in only another one of the end fittings 12.

Further, the end fitting 12 is formed of a plate material having a flat-plate-ring shape. In addition, various shapes may be employed, for example, such a shape that a skirt portion made of a steel tube is interposed between a back surface of the end fitting and the steel pipe 11.

Reference Signs List

[0053] 1 pile
 10 pile body
 11 steel pipe
 12 end fitting
 12a joining surface
 12b inner peripheral surface of end fitting

13 protruding thread

15 arc-shaped plate

16 gap

17 recessed groove

19 flat surface portion

20 arc-shaped-plate interconnecting protrusion

20a plate-end-side surface

20b plate-center-side surface

21 arc-shaped-plate interconnecting fitting

22 tapered dovetail groove

25 bolt insertion hole

26 screw hole

27 bolt

30 shear ring fitting portion

30a groove bottom

31 shear ring

32 recess

33 projection

b1 joining surface opening width of shear ring fitting portion

b2 tip width of shear ring

Claims

[Claim 1] A weldless joint for piles, comprising:

end fittings respectively arranged at joining end portions of piles to be connected to each other; and

a plurality of arc-shaped plates fitted over the end fittings so as to be arranged around outer peripheries of the end fittings,

the end fittings comprising flange-shaped protruding threads formed integrally along the outer peripheries thereof,

the plurality of arc-shaped plates comprising recessed grooves formed in inner peripheral surfaces thereof, the protruding threads of the end fittings being fitted in the recessed grooves,

the piles being connected to each other by fitting the protruding threads in the recessed grooves so as to fit the plurality of arc-shaped plates on the outer peripheries of the end fittings,

wherein the end fittings comprise shear ring fitting portions having a circular ring shape, respectively, the shear ring fitting portions being formed in joining surfaces of the end fittings, respectively, and being arranged coaxially with the end fittings,

wherein a shear ring having a circular ring shape is interposed astride the shear ring fitting portions in the joining surfaces,

wherein the shear ring fitting portions each comprise a projection formed on a bottom surface thereof by partially heightening the bottom surface,

wherein the shear ring integrally comprises a recess in which the projection is fitted, the recess being formed in each of upper

and lower surfaces of the shear ring at a position corresponding to the projection on the bottom surface, and

wherein the projection on the bottom surface is fitted in the recess in the each of the upper and lower surfaces of the shear ring so that the shear ring and the end fittings are prevented from relatively moving in a circumferential direction, to thereby transmit a moment of rotation between the piles to be connected upright.

[Claim 2] A weldless joint for piles according to claim 1, further comprising an arc-shaped-plate interconnecting fitting having a plate-like shape, the arc-shaped-plate interconnecting fitting being fixed over outer surfaces of end portions of adjacent arc-shaped plates of the plurality of arc-shaped plates, to thereby connect the plurality of arc-shaped plates together,

wherein the arc-shaped-plate interconnecting fitting has a tapered dovetail groove formed therein, the tapered dovetail groove having a dovetail-groove-shaped cross-section and being formed into such a tapered shape that any one of upper and lower sides of the tapered dovetail groove is narrow,

wherein the adjacent arc-shaped plates comprise arc-shaped-plate interconnecting protrusions formed on the outer surfaces of the end portions thereof, respectively, the arc-shaped-plate interconnecting protrusions each having a shape obtained by vertically dividing in half a tapered dovetail shape

that is fitted to the tapered dovetail groove,

wherein the arc-shaped-plate interconnecting protrusions are inserted into the tapered dovetail groove so that the arc-shaped-plate interconnecting fitting connects the adjacent arc-shaped plates together, and

wherein end portions of the arc-shaped-plate interconnecting fitting are screwed onto the adjacent arc-shaped plates.

[Claim 3] A weldless joint for piles according to claim 1 or 2, wherein the shear ring fitting portions are formed into a groove shape in surfaces of the joining surfaces of the end fittings, respectively.

[Claim 4] A weldless joint for piles according to claim 1 or 2, wherein the shear ring fitting portions are each formed into an annular shape obtained by shaving, in a stepped manner, a corner defined by the joining end surface and an inner peripheral rim surface of an end plate center opening formed in a center of each of the end fittings, and

wherein the shear ring having the circular ring shape is fitted on the inner peripheral surface of the end plate center opening.

[Claim 5] A weldless joint for piles according to claim 3 or 4, wherein the shear ring fitting portions of the end fittings are each formed into such a tapered shape that the bottom surface

side is narrower than a joining surface opening side, and

wherein upper and lower sides of an inner peripheral surface of the shear ring and upper and lower sides of an outer peripheral surface of the shear ring are each formed into a tapered shape conforming to each of the shear ring fitting portions.

[Claim 6] A weldless joint for piles according to claim 1,

wherein the shear ring is formed integrally with one of the end fittings in a protruding manner so as to have such a trapezoid cross-section that a protruding end portion side is narrow, and

wherein the shear ring is fitted in the shear ring fitting portion that is formed in another one of the end fittings so as to have a shape conforming to the trapezoid shape of the shear ring formed integrally with the one of the end fittings.