

DESCRIPTION

COLUMN-PILE CONNECTING METHOD AND CONNECTING STRUCTURE

Field

5 [0001] The present invention relates to a column-pile connecting method and a connecting structure in a steel-frame construction.

Background

10 [0002] Structures for connecting a column and a pile in a steel-frame construction are conventionally known (see, for example, Patent Literature 1 or 2). FIG. 12 illustrates an example of a conventional column-pile connecting structure. As illustrated in this drawing, to connect a steel column 1 of a steel-frame construction and
15 a steel pipe pile 2, which is a steel pipe embedded in the ground, firstly, a joint member 3, which forms a lower end portion of the steel column 1, and the steel pipe pile 2 are manufactured in a factory or the like and conveyed to a construction site.

20 [0003] At the construction site, a vertical hole 4 having an internal diameter that is slightly larger than an external diameter of the steel pipe pile 2 and has a predetermined depth is bored at a predetermined position using, for instance, an auger. Next, the steel pipe pile 2
25 is inserted into the vertical hole 4 to be stood upright. Subsequently, if concrete is to be poured into the pile, concrete 5 is poured into the steel pipe pile 2.

[0004] After the poured concrete 5 has been hardened, the joint member 3 is aligned to a position predetermined
30 for the steel column 1 of the upper construction and inserted into the steel pipe pile 2. The joint member 3 of the illustrated example includes horizontally-extending beams 3a. Concrete 6 is poured into a space between the

joint member 3 and the steel pipe pile 2. Lastly, after pouring concrete 7 into between the vertical hole 4 and the steel pipe pile 2 and above the steel pipe pile 2, the steel column 1 of the upper construction is connected to a connecting portion 8, which is on the upper side of the joint member 3 and exposed above a ground level GL.

Citation List

Patent Literature

[0005] Patent Literature 1: Japanese Patent No. 3246321

10 Patent Literature 2: Japanese Patent No. 3175586

Summary

Technical Problem

[0006] In the conventional column-pile connecting structure, a base plate 9 is typically placed on a lower end surface 1a of the steel column 1 (in the above-described example of FIG. 12, a lower end surface of the joint member 3) so that load of the upper construction is appropriately transmitted to the steel pipe pile 2 as illustrated in section (a) of FIG. 13. Meanwhile, a pull-out force P1 can act on the steel column 1 at a connecting portion between the steel column 1 and the steel pipe pile 2 and undesirably pull out the steel column 1 from the steel pipe pile 2. Hence, the base plate 9 is designed as a plate member having a contour projecting laterally a small amount from an external diameter of the steel column 1 to resist this pull-out force P1.

[0007] In such a connecting structure, as illustrated in section (b) of FIG. 13, the base plate 9 is typically shaped to project; an internally-ribbed steel pipe having internal ribs 2a on its inside surface is typically employed as the steel pipe pile 2. In this case, when the column pull-out force P1 is applied, a compression force P2 acts on the concrete 6 between the base plate 9 and the

internal ribs 2a of the steel pipe pile 2. This compression force P2 acts on a projecting portion of the base plate 9 as a pull-out resistance force of a column base. A pull-out prevention function is consequently
5 provided.

[0008] In piling of the steel pipe pile 2, a construction error from several centimeters to several tens of centimeters can occur in the horizontal direction depending on a soil condition or a construction method. In
10 such a situation, as illustrated in FIG. 14, a column center C1 of the steel column 1 will go considerably out of horizontal alignment with respect to a pile center C2 of the steel pipe pile 2. This can result in a failure to insert the lower end portion of the steel column 1 into the
15 steel pipe pile 2 or, even when the lower end portion is successfully inserted, because the base plate 9 at the lower end portion of the steel column 1 projects laterally beyond the external diameter of the steel column 1, lead to narrow spacing between the base plate 9 and the inside
20 surface of the steel pipe pile 2. This can bring about a situation where the concrete 6 is insufficiently poured into, for instance, a region S on the lower surface side of the base plate 9 on the side where the spacing is narrow and the concrete fails to provide intended resistance to
25 compression, resulting in a failure to appropriately function as the connecting portion when a force, such as a pull-out force, acts on the column.

[0009] The present invention has been conceived in light of the above and aims at providing a column-pile connecting
30 method and a connecting structure that allow, when a center of a column and a center of a pile are horizontally out of alignment, inserting a lower end portion of the column into the pile and appropriately pouring a hardening material,

such as concrete, around a projecting member, e.g., a base plate.

Solution to Problem

[0010] To solve the problem and achieve the object, a
5 column-pile connecting method for connecting a pile and a
column together, wherein the pile is a steel pipe having an
open upper end, and the column is made of steel and
including a lower end portion inserted and placed in an
upper end portion of the pile, the pile and the column are
10 connected together via a projecting member projecting
laterally at the lower end portion of the column and a
hardening material poured into a space between the column
and the pile according to the present invention is a method
including: when a column center of the column and a pile
15 center of the pile are to be positioned out of horizontal
alignment, creating a gap between a projecting portion, the
projecting portion being on a side most adjacent to an
inside surface of the pile, of the projecting member and
the inside surface of the pile by performing a shape-
20 changing work on the projecting member or changing a
position where the projecting member is placed.

[0011] Moreover, in the column-pile connecting method
according to the present invention, the projecting member
is a base plate projecting laterally and coaxially with the
25 column center of the column on a lower end surface of the
column, and the method further includes boring a
vertically-extending through hole in a center portion of
the base plate to enable pouring the hardening material
from above to below the base plate through the through hole.

30 [0012] Moreover, in the column-pile connecting method
according to the present invention, the projecting member
is a base plate projecting laterally and coaxially with the
column center of the column on a lower end surface or at

its vicinity of the column, and the method further includes comprising creating a chipped-off portion by cutting a part of the projecting portion on the side most adjacent to the inside surface of the pile of the base plate to create a gap between the chipped-off portion and the inside surface of the pile.

[0013] Moreover, the column-pile connecting method according to the present invention further includes providing a laterally-projecting protruding rib on an outer peripheral surface of the column immediately above the chipped-off portion.

[0014] Moreover, in the column-pile connecting method according to the present invention, the projecting member is protruding ribs projecting laterally from an outer peripheral surface of the column, and the method further includes creating a gap between each of the ribs and the inside surface of the pile by providing the ribs on the lower end portion of the column in a plurality of rows apart from each other in the vertical direction.

[0015] Moreover, a column-pile connecting structure for connecting a pile and a column together, wherein the pile is a steel pipe having an open upper end, and the column is made of steel and including a lower end portion inserted and placed in an upper end portion of the pile, the pile and the column are connected together via a projecting member projecting laterally at the lower end portion of the column and a hardening material poured into a space between the column and the pile according to the present invention includes: an out-of-horizontal-alignment arrangement of a column center of the column and a pile center of the pile; and a projecting portion, the projecting portion being a part of the projecting member on a side most adjacent to an inside surface of the pile, creating a gap between the

projecting member and the inside surface of the pile.

[0016] Moreover, in the column-pile connecting structure according to the present invention, the projecting member is a base plate projecting laterally and coaxially with the column center of the column on a lower end surface of the column, and the base plate includes a vertically-extending through hole in a center portion of the base plate, the through hole allowing pouring the hardening material from above to below the base plate through the through hole.

[0017] Moreover, in the column-pile connecting structure according to the present invention, the projecting member is a base plate projecting laterally and coaxially with the column center of the column on a lower end surface or at its vicinity of the column, and the base plate includes a chipped-off portion in a part of the projecting portion on the side most adjacent to the inside surface of the pile such that a gap is created between the chipped-off portion and the inside surface of the pile.

[0018] Moreover, the column-pile connecting structure according to the present invention, further includes a laterally-projecting protruding rib on an outer peripheral surface of the column immediately above the chipped-off portion.

[0019] Moreover, in the column-pile connecting structure according to the present invention, the projecting member is protruding ribs projecting laterally from an outer peripheral surface of the column, and the ribs are provided on the lower end portion of the column in a plurality of rows apart from each other in the vertical direction, creating a gap between each of the ribs and the inside surface of the pile.

Advantageous Effects of Invention

[0020] According to an aspect of the present invention,

a column-pile connecting method for connecting a pile, which is a steel pipe having an open upper end, and a column made of steel and including a lower end portion inserted and placed in an upper end portion of the pile together via a projecting member projecting laterally at the lower end portion of the pile and a hardening material poured into a space between the column and the pile includes, when a column center of the column and a pile center of the pile are to be positioned out of horizontal alignment, creating a gap between a projecting portion, which is on a side most adjacent to an inside surface of the pile, of the projecting member and the inside surface of the pile by performing a shape-changing work on the projecting member or changing a position where the projecting member is placed. Hence, advantageously, the lower end portion of the column can be inserted and placed inside the pile and, furthermore, the hardening material can be appropriately poured around the projecting member through the created gap.

[0021] According to another aspect of the present invention, in the column-pile connecting method, the projecting member is a base plate projecting laterally and coaxially with the column center of the column on a lower end surface of the column, and the method further includes boring a vertically-extending through hole in a center portion of the base plate to enable pouring the hardening material from above to below the base plate through the through hole. Hence, the hardening material can be advantageously poured to the lower surface side of the base plate densely.

[0022] According to another aspect of the present invention, in the column-pile connecting method, the projecting member is a base plate projecting laterally and

coaxially with the column center of the column on a lower end surface or at its vicinity of the column, and the method further includes creating a chipped-off portion by cutting a part of the projecting portion on the side most adjacent to the inside surface of the pile of the base plate to create a gap between the chipped-off portion and the inside surface of the pile. Hence, advantageously, the lower end portion of the column can be inserted and placed inside the pile and, furthermore, the hardening material can be appropriately poured around the projecting member through the created gap. In addition, even when the column center of the column and the pile center of the pile are found to be out of horizontal alignment at a construction site, the gap can be created advantageously easily and in a short period of time by cutting a part of the base plate.

[0023] According to another aspect of the present invention, the column-pile connecting method further includes providing a laterally-projecting protruding rib on an outer peripheral surface of the column immediately above the chipped-off portion. Hence, advantageously, while maintaining concrete pouring characteristics, a bearing force and a pull-out resistance force can be achieved by compensating a reduction in pressure bearing area of the base plate resulting from creating the chipped-off portion.

[0024] According to another aspect of the present invention, in the column-pile connecting method, the projecting member is protruding ribs projecting laterally from an outer peripheral surface of the column, and the method further includes creating a gap between each of the ribs and the inside surface of the pile by providing the ribs on the lower end portion of the column in a plurality of rows apart from each other in the vertical direction. Hence, a pressure bearing area equivalent to that of the

base plate can be obtained even when a projection amount of each of the ribs is smaller than a projection amount of the base plate, and a bearing force and a pull-out resistance force equivalent to those of the base plate can be achieved.

5 As a result, the gap between the ribs of the column and the inside surface of the pile can be advantageously widened.

[0025] According to an aspect of the present invention, a column-pile connecting structure where a pile, which is a steel pipe having an open upper end, and a column made of
10 steel and including a lower end portion inserted and placed in an upper end portion of the pile are connected together via a projecting member projecting laterally at the lower end portion of the pile and a hardening material poured into a space between the column and the pile includes an
15 out-of-horizontal-alignment arrangement of a column center of the column and a pile center of the pile, and a projecting portion, which is a part of the projecting member on a side most adjacent to an inside surface of the pile, creating a gap between the projecting member and the
20 inside surface of the pile. Hence, advantageously, the lower end portion of the column can be inserted and placed inside the pile and, furthermore, the hardening material can be appropriately poured around the projecting member through the created gap.

25 [0026] According to another aspect of the present invention, in the column-pile connecting structure, the projecting member is a base plate projecting laterally and coaxially with the column center of the column on a lower end surface of the column, and the base plate has a
30 vertically-extending through hole in a center portion of the base plate, the through hole allowing pouring the hardening material from above to below the base plate through the through hole. This can advantageously make the

hardening material poured to the lower surface side of the base plate dense.

[0027] According to another aspect of the present invention, in the column-pile connecting structure, the projecting member is a base plate projecting laterally and coaxially with the column center of the column on the lower end surface or at its vicinity of the column. The base plate includes a chipped-off portion in a part of the projecting portion on the side most adjacent to the inside surface of the pile such that a gap is created between the chipped-off portion and the inside surface of the pile. Hence, advantageously, the lower end portion of the column can be inserted and placed inside the pile and, furthermore, the hardening material can be appropriately poured around the projecting member through the created gap. In addition, even when the column center of the column and the pile center of the pile are found to be out of horizontal alignment at a construction site, the connecting structure, in which the gap is created, can be obtained advantageously easily and in a short period of time by cutting a part of the base plate.

[0028] According to another aspect of the present invention, the column-pile connecting structure further includes a laterally-projecting protruding rib on an outer peripheral surface of the column immediately above the chipped-off portion. Hence, advantageously, a bearing force and a pull-out resistance force can be achieved by compensating a reduction in pressure bearing area of the base plate resulting from creating the chipped-off portion.

[0029] According to another aspect of the present invention, in the column-pile connecting structure, the projecting member is protruding ribs projecting laterally from the outer peripheral surface of the column, and the

ribs are provided on the lower end portion of the column in a plurality of rows apart from each other in the vertical direction, creating a gap between each of the ribs and the inside surface of the pile. Hence, a pressure bearing area equivalent to that of the base plate can be obtained even when a projection amount of each of the ribs is smaller than a projection amount of the base plate, and a bearing force and a pull-out resistance force equivalent to those of the base plate can be achieved. This advantageously allows widening the gap between the ribs of the column and the inside surface of the pile.

Brief Description of Drawings

[0030] FIG. 1 is a vertical cross section illustrating a first embodiment of the present invention.

FIG. 2 is a side view describing a projection amount of a base plate of the first embodiment of the present invention.

FIG. 3 is a horizontal cross section illustrating the first embodiment of the present invention.

FIG. 4 is a horizontal cross section illustrating an example modification of the first embodiment of the present invention.

FIG. 5 is a horizontal cross section illustrating an example modification of the first embodiment of the present invention.

FIG. 6 is a vertical cross section illustrating a second embodiment of the present invention.

FIG. 7 is a vertical cross section illustrating a third embodiment of the present invention.

FIG. 8 is a vertical cross section illustrating a fourth embodiment of the present invention.

FIG. 9 is a side view describing a projection amount of ribs of the fourth embodiment of the present invention.

FIG. 10 is a horizontal cross section describing the projection amount of the ribs of the fourth embodiment of the present invention.

FIG. 11 is a vertical cross section of ribs
5 illustrating an example modification of the fourth embodiment of the present invention.

FIG. 12 is a vertical cross section illustrating an example of a conventional column-pile connecting structure.

FIG. 13 is a vertical cross section illustrating an
10 example of a conventional column-pile connecting structure including a base plate, in which section (a) is an example where a pile is not internally ribbed, section (b) is an example where the pile is internally ribbed.

FIG. 14 is a vertical cross section illustrating an
15 example of the conventional column-pile connecting structure including the base plate in a situation where centers go out of alignment.

Description of Embodiments

[0031] Column-pile connecting methods and connecting
20 structures according to embodiments of the present invention are described in detail below with reference to the drawings. The embodiments are not intended to limit the present invention.

[0032] [First Embodiment]

25 A first embodiment of the present invention is described first.

As illustrated in FIG. 1, a column-pile connecting structure 100 of the first embodiment is obtained by connecting, in a steel-frame construction, a pile 10, which
30 is a steel pipe having an open upper end, and a column 16 made of steel and including a lower end portion (hereinafter, referred to as "column base") 14 inserted and placed in an upper end portion (hereinafter, referred to as

"pile head") 12 of the pile 10 together via a projecting member 18 projecting laterally at the column base 14 and a hardening material 20 poured into a space between the column 16 and the pile 10.

5 [0033] The pile 10 can be, for instance, a steel pipe pile or a cast-in-place pile with a steel pipe wound around its head. A round steel pipe or a square or rectangular steel pipe pile having an inside surface, to which a rib formed of a rebar or a flat bar or a protruding rib formed
10 by rolling a pipe base plate is attached, can be used as the pile head 12. The description below is made through an example of a round steel pipe having an inside surface that is not ribbed.

[0034] The column base 14 can be a steel product of a
15 desired shape, examples of which include a round steel pipe, a square or rectangular steel pipe, and an H-beam. A rib formed of a rebar or a flat bar may be provided on an inside surface of the column base 14. A cement-based material, such as concrete or mortar, can be used as the
20 hardening material 20. The description below is made through an example, in which concrete 22 is used.

[0035] As the projecting member 18, a disc-like steel base plate 24 that projects laterally and coaxially with the column center C1 of the column 16 on a lower end
25 surface of the column base 14 can be used. As illustrated in FIG. 2, the base plate 24 is typically designed to have a projection amount L smaller than or equal to the thickness of the base plate so that the base plate 24 can effectively transmit a pull-out resistance force to the
30 column base. The base plate 24 may alternatively be provided in a fashion to project from an outer peripheral surface of the column 16 near the lower end surface rather than provided on the lower end surface of the column base

14. The pull-out resistance force varies with the position where the base plate 24 is mounted such that the pull-out resistance force increases toward the lower end surface of the column base 14. Accordingly, the base plate 24 is most preferably mounted on the lower end surface.

[0036] According to the column-pile connecting method of the first embodiment, as illustrated in FIG. 1 and FIG. 3, when the column center C1 of the column 16 and the pile center C2 of the pile 10 are to be positioned out of horizontal alignment, a chipped-off portion 26 is created by cutting a part of a projecting portion, which is on a side most adjacent to the inside surface of the pile 10, of the base plate 24. This cutting work can be performed at, for instance, an above-ground construction site.

[0037] After being subjected to this cutting work, the column base 14 is inserted and placed in the pile head 12 with the column center C1 and the pile center C2 placed out of horizontal alignment by a predetermined distance to create a gap V of a predetermined size between the chipped-off portion 26 and the inside surface of the pile 10.

Conversely, the gap V between the base plate 24 at the column base 14 and the inside surface of the pile 10 created by the chipped-off portion 26 enables or facilitates insertion of the column base 14. Thereafter, the concrete 22 injected from above to inside the column base 14 fills a space between the column base 14 and the pile head 12 and is hardened, thereby connecting the column base 14 and the pile head 12 together. In this process, the concrete 22 flown from above into the chipped-off

portion 26 of the base plate 24 can reach the lower surface side of the base plate 24 by passing through the gap V and going around as indicated by a direction R indicated by the dashed line in FIG. 1; hence, the concrete 22 can be poured

into this portion densely. The gap V denoted above means a gap having an opening of a size that allows pouring 20-millimeter aggregate smoothly in concrete pouring and is a gap created by placing a rim of the base plate 24 and the inside surface of the pile 10 away from each other by a separation distance of at least approximately 25 millimeters.

[0038] As described above, according to the first embodiment, when centers go out of horizontal alignment at a piling position, the column base 14 can be inserted inside the pile head 12. Hence, work of inserting the column base 14 can be facilitated. Furthermore, the concrete 22 can be poured into the lower surface side and the like of the base plate 24 easily and appropriately though the created gap V, providing favorable concrete pouring characteristics. Furthermore, the gap V can be created easily and in a short period of time by performing a shape-changing work on the base plate 24 by cutting a part thereof at a construction site where the pile 10 is found to be out of center alignment.

[0039] The above-described embodiment has been described through the example where a round steel pipe is used as the column base 14 (the column 16); however, as described above, the present invention is not limited thereto.

Alternatively, for instance, a square or rectangular steel pipe can be used as the column 16 as illustrated in FIG. 4; further alternatively, an H-beam can be used as the column 16 as illustrated in FIG. 5. When a square or rectangular steel pipe or an H-beam is used as the column 16, a rectangular plate member can be used as the base plate 24.

[0040] In the embodiment described above, the column base 14 may be configured as is a joint member (see the joint member 3 of FIG. 12) of a conventional connecting

structure. In this case, as illustrated in FIG. 1, after connecting the column base 14 serving as the joint member and the pile head 12 together, the column can be connected to a top side of the column base 14.

5 [0041] [Second Embodiment]

A second embodiment of the present invention is described below.

As illustrated in FIG. 6, a column-pile connecting structure 200 of the second embodiment differs from the
10 above-described first embodiment in that a vertically-extending through hole 28 is bored in a center portion of the base plate 24. The through hole 28 can be, for instance, a circular opening concentric with the base plate 24. The through hole 28 bored in the base plate 24 allows
15 pouring the concrete 22 from above inside the column base 14 to below the base plate 24.

[0042] Hence, according to the second embodiment, the concrete 22 can be poured into the lower surface side of the base plate 24 densely. In particular, when the column
20 base 14 is large in diameter, a situation where it is difficult to pour concrete to the lower surface side of the base plate 24 densely can occur; however, pouring concrete to the lower surface side of the base plate 24 densely is enabled by pouring the concrete through the through hole 28
25 in the center portion of the base plate 24. The number of the through holes 28 bored in the center portion may be either only one, or two or more.

[0043] [Third Embodiment]

A third embodiment of the present invention is
30 described below.

As illustrated in FIG. 7, a column-pile connecting structure 300 of the third embodiment differs from the above-described first or second embodiment in that a

laterally-projecting protruding rib 32 is provided on the outer peripheral surface of the column base 14 immediately above the chipped-off portion 26. The rib 32 may be formed using, for instance, a small-diameter rebar. The rib 32
5 formed of a rebar or the like is placed and fixed onto the outer surface of the column base 14 by flare welding, for instance.

[0044] According to the third embodiment, while maintaining concrete pouring characteristics, the rib 32
10 provided on the outer peripheral surface of the column base 14 immediately above the chipped-off portion 26 compensates a reduction in pressure bearing area of the base plate 24 resulting from creating the chipped-off portion 26; hence, a bearing force and a pull-out resistance force equivalent
15 to those of the configuration on which the cutting is not performed can be achieved.

[0045] [Fourth Embodiment]

A fourth embodiment of the present invention is described below.

20 As illustrated in FIG. 8, a column-pile connecting structure 400 of the fourth embodiment differs from the above-described first embodiment in that ribs 34 are used as the projecting member 18 in lieu of the base plate 24 to thereby change the position where the projecting member 18
25 is placed.

[0046] The ribs 34, which are protruding ribs laterally projecting from the outer peripheral surface of the column 16, may be formed of, for instance, a rebar, a flat bar, or protrusions formed on the outer peripheral surface formed
30 by rolling. The ribs 34 are provided on the column base 14 in a plurality of rows spaced from each other in the vertical direction, creating the gap V between each of the ribs 34 and the inside surface of the pile 10. As

illustrated in FIG. 9 and FIG. 10, a projection amount M, which depends on the number of the rows, of the rib 34 is smaller than the above-described projection amount L (see FIG. 2) of the base plate 24. For instance, a protrusion height (the projection amount M) of the ribs that are provided in a plurality of rows will provide a pull-out resistance force that is determined by approximately a sum of protrusion heights of the ribs. For this reason, when the ribs are provided in three rows, a pull-out resistance force equivalent to that of the comparison-reference base plate can be achieved with a protrusion height that is one-third as large as the protrusion height (the projection amount L) of the comparison-reference base plate.

[0047] According to the fourth embodiment, a pressure bearing area equivalent to that of the base plate 24 can be obtained even when the projection amount M of each of the ribs 34 is smaller than the projection amount L of the base plate 24, and a bearing force and a pull-out resistance force equivalent to those of the base plate 24 can be achieved. This allows widening the gap V between the ribs 34 of the column base 14 and the inside surface of the pile head 12 to be larger than that of the configuration where the base plate 24 is provided.

[0048] In addition to the ribs 34 on the outer peripheral surface of the column base 14, similar ribs 36 may be provided on an inner peripheral surface of the column base 14 as illustrated in FIG. 11. In this case, the ribs 34 and the ribs 36 internally and externally provided on the column base 14 can provide a larger pressure bearing area.

[0049] As described above, according to an aspect of the present invention, a column-pile connecting method for connecting a pile, which is a steel pipe having an open

upper end, and a column made of steel and including a lower end portion inserted and placed in an upper end portion of the pile together via a projecting member projecting laterally at the lower end portion of the column and a
5 hardening material poured into a space between the column and the pile includes, when a column center of the column and a pile center of the pile are to be positioned out of horizontal alignment, creating a gap between a projecting portion, which is on a side most adjacent to an inside
10 surface of the pile, of the projecting member and the inside surface of the pile by performing a shape-changing work on the projecting member or changing a position where the projecting member is placed. Hence, the lower end portion of the column can be inserted and placed inside the
15 pile and, furthermore, the hardening material can be appropriately poured around the projecting member through the created gap.

[0050] According to another aspect of the present invention, in the column-pile connecting method, the
20 projecting member is a base plate projecting laterally and coaxially with the column center of the column on a lower end surface of the column, and the method further includes boring a vertically-extending through hole in a center portion of the base plate to enable pouring the hardening
25 material from above to below the base plate through the through hole. Hence, the hardening material can be poured to the lower surface side of the base plate densely.

[0051] According to another aspect of the present invention, in the column-pile connecting method, the
30 projecting member is a base plate projecting laterally and coaxially with the column center of the column on a lower end surface or at its vicinity of the column, and the method further includes creating a chipped-off portion by

cutting a part of the projecting portion on the side most adjacent to the inside surface of the pile of the base plate to create a gap between the chipped-off portion and the inside surface of the pile. Hence, the lower end
5 portion of the column can be inserted and placed inside the pile and, furthermore, the hardening material can be appropriately poured around the projecting member through the created gap. In addition, even when the column center of the column and the pile center of the pile are found to
10 be out of horizontal alignment at a construction site, the gap can be created easily and in a short period of time by cutting a part of the base plate.

[0052] According to another aspect of the present invention, the column-pile connecting method further
15 includes providing a laterally-projecting protruding rib on an outer peripheral surface of the column immediately above the chipped-off portion. Hence, while maintaining concrete pouring characteristics, a bearing force and a pull-out resistance force can be achieved by compensating a
20 reduction in pressure bearing area of the base plate resulting from creating the chipped-off portion.

[0053] According to another aspect of the present invention, in the column-pile connecting method, the projecting member is protruding ribs projecting laterally
25 from an outer peripheral surface of the column, and the method further includes creating a gap between each of the ribs and the inside surface of the pile by providing the ribs on the lower end portion of the column in a plurality of rows apart from each other in the vertical direction.
30 Hence, a pressure bearing area equivalent to that of the base plate can be obtained even when a projection amount of each of the ribs is smaller than a projection amount of the base plate, and a bearing force and a pull-out resistance

force equivalent to those of the base plate can be achieved. As a result, the gap between the ribs of the column and the inside surface of the pile can be widened.

[0054] According to an aspect of the present invention,
5 a column-pile connecting structure where a pile, which is a steel pipe having an open upper end, and a column made of steel and including a lower end portion inserted and placed in an upper end portion of the pile are connected together via a projecting member projecting laterally at the lower
10 end portion of the pile and a hardening material poured into a space between the column and the pile includes an out-of-horizontal-alignment arrangement of a column center of the column and a pile center of the pile, and a projecting portion, which is a part of the projecting
15 member on a side most adjacent to an inside surface of the pile, creating a gap between the projecting member and the inside surface of the pile. Hence, the lower end portion of the column can be inserted and placed inside the pile and, furthermore, the hardening material can be
20 appropriately poured around the projecting member through the created gap.

[0055] According to another aspect of the present invention, in the column-pile connecting structure, the projecting member is a base plate projecting laterally and
25 coaxially with the column center of the column on a lower end surface of the column, and the base plate has a vertically-extending through hole in a center portion of the base plate, the through hole allowing pouring the hardening material from above to below the base plate
30 through the through hole. This can make the hardening material poured to the lower surface side of the base plate dense.

[0056] According to another aspect of the present

invention, in the column-pile connecting structure, the projecting member is a base plate projecting laterally and coaxially with the column center of the column on the lower end surface or at its vicinity of the column. The base
5 plate includes a chipped-off portion in a part of the projecting portion on the side most adjacent to the inside surface of the pile such that a gap is created between the chipped-off portion and the inside surface of the pile. Hence, the lower end portion of the column can be inserted
10 and placed inside the pile and, furthermore, the hardening material can be appropriately poured around the projecting member through the created gap. In addition, even when the column center of the column and the pile center of the pile are found to be out of horizontal alignment at a
15 construction site, the connecting structure, in which the gap is created, can be obtained easily and in a short period of time by cutting a part of the base plate.

[0057] According to another aspect of the present invention, the column-pile connecting structure further
20 includes a laterally-projecting protruding rib on an outer peripheral surface of the column immediately above the chipped-off portion. Hence, a bearing force and a pull-out resistance force can be achieved by compensating a reduction in pressure bearing area of the base plate
25 resulting from creating the chipped-off portion.

[0058] According to another aspect of the present invention, in the column-pile connecting structure, the projecting member is protruding ribs projecting laterally from the outer peripheral surface of the column, and the
30 ribs are provided on the lower end portion of the column in a plurality of rows apart from each other in the vertical direction, creating a gap between each of the ribs and the inside surface of the pile. Hence, a pressure bearing area

equivalent to that of the base plate can be obtained even when a projection amount of each of the ribs is smaller than a projection amount of the base plate, and a bearing force and a pull-out resistance force equivalent to those of the base plate can be provided. This allows widening the gap between the ribs of the column and the inside surface of the pile.

Industrial Applicability

[0059] As described above, column-pile connecting methods and connecting structures according to the present invention are useful in connecting a column and a pile in a steel-frame construction and particularly suited to, when a column center and a pile center are horizontally out of alignment, inserting a lower end portion of the column into the pile and appropriately pouring a hardening material, such as concrete, around a projecting member, e.g., a base plate.

Reference Signs List

[0060] 10 pile

20 12 pile head (upper end portion)
14 column base (lower end portion)
16 column
18 projecting member
20 hardening material

25 22 concrete (hardening material)
24 base plate (projecting member)
26 chipped-off portion
28 through hole
30 tremie pipe

30 32, 36 rib(s)
34 ribs (projecting member)
100, 200, 300, 400 column-pile connecting structure
C1 column center

C2 pile center
D diameter
L, M projection amount
R direction
5 V gap

CLAIMS

1. A column-pile connecting method for connecting a pile and a column together, wherein the pile is a steel pipe having an open upper end, and the column is made of steel and including a lower end portion inserted and placed in an upper end portion of the pile, the pile and the column are connected together via a projecting member projecting laterally at the lower end portion of the column and a hardening material poured into a space between the column and the pile, and the pile and the column are connected together in a state that a column center of the column and a pile center of the pile are positioned out of horizontal alignment, the method comprising

creating a gap between a projecting portion, the projecting portion being on a side most adjacent to an inside surface of the pile, of the projecting member and the inside surface of the pile by performing a shape-changing work on the projecting member or changing a position where the projecting member is placed to the column.

2. The column-pile connecting method according to claim 1, wherein

the projecting member is a base plate projecting laterally and coaxially with the column center of the column on a lower end surface of the column, and

the method further comprising boring a vertically-extending through hole in a center portion of the base plate to enable pouring the hardening material from above to below the base plate through the through hole.

3. The column-pile connecting method according to claim 1,

wherein

the projecting member is a base plate projecting laterally and coaxially with the column center of the column on a lower end surface or at its vicinity of the column, and

the method further comprising creating a chipped-off portion by cutting a part of the projecting portion on the side most adjacent to the inside surface of the pile of the base plate to create a gap between the chipped-off portion and the inside surface of the pile.

4. The column-pile connecting method according to claim 3, further comprising providing a laterally-projecting protruding rib on an outer peripheral surface of the column immediately above the chipped-off portion.

5. The column-pile connecting method according to claim 1, wherein

the projecting member is protruding ribs projecting laterally from an outer peripheral surface of the column, and

the method further comprising creating a gap between each of the ribs and the inside surface of the pile by providing the ribs on the lower end portion of the column in a plurality of rows apart from each other in the vertical direction.

6. A column-pile connecting structure for connecting a pile and a column together, wherein the pile is a steel pipe having an open upper end, and the column is made of steel and including a lower end portion inserted and placed in an upper end portion of the pile, the pile and the column are connected together via a projecting member

projecting laterally at the lower end portion of the column and a hardening material poured into a space between the column and the pile, the structure comprising:

an out-of-horizontal-alignment arrangement of a column
5 center of the column and a pile center of the pile; and

a projecting portion, the projecting portion being a part of the projecting member on a side most adjacent to an inside surface of the pile, creating a gap between the projecting member and the inside surface of the pile.

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7. The column-pile connecting structure according to claim 6, wherein

the projecting member is a base plate projecting laterally and coaxially with the column center of the
15 column on a lower end surface of the column, and

the base plate includes a vertically-extending through hole in a center portion of the base plate, the through hole allowing pouring the hardening material from above to below the base plate through the through hole.

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8. The column-pile connecting structure according to claim 6, wherein

the projecting member is a base plate projecting laterally and coaxially with the column center of the
25 column on a lower end surface or at its vicinity of the column, and

the base plate includes a chipped-off portion in a part of the projecting portion on the side most adjacent to the inside surface of the pile such that a gap is created
30 between the chipped-off portion and the inside surface of the pile.

9. The column-pile connecting structure according to

claim 8, further comprising a laterally-projecting protruding rib on an outer peripheral surface of the column immediately above the chipped-off portion.

5 10. The column-pile connecting structure according to claim 6, wherein

the projecting member is protruding ribs projecting laterally from an outer peripheral surface of the column, and

10 the ribs are provided on the lower end portion of the column in a plurality of rows apart from each other in the vertical direction, creating a gap between each of the ribs and the inside surface of the pile.