ABSTRACT

A foundation pile includes a tubular wall, a top cap covering a top end of the tubular wall, a partition plate disposed transversely in the tubular wall below the top cap and dividing an inner space of the tubular wall into upper and lower spaces, two opposite fixing holes extending radially through the tubular wall and communicated with the upper space, and a plurality of pressure release holes extending radially through the tubular wall and communicated with the lower space. The partition plate prevents concrete slurry from flowing into the upper space. The pressure release holes allow the concrete to consolidate therein and to thereby increase transverse binding forces with the foundation pile. A method of installing the foundation pile is also disclosed.
FIG. 1
PRIOR ART
DRILLING

POURING CONCRETE

LOWERING THE FOUNDATION PILE

OPENING THE FOUNDATION PILE

ANCHORING A REINFORCING CAGE

FILLING CONCRETE

FIG. 7
FOUNDATION PILE AND INSTALLING METHOD THEREOF

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority of Taiwanese Application No. 100118113 filed on May 24, 2011.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates to a foundation pile for a building construction and a method of installing the foundation pile.

[0004] 2. Description of the Related Art

[0005] In order to increase safety and improve stability of building constructions, foundation piles are installed under the ground to support building constructions and to transfer the loads thereof to hard bearing strata in the ground. Especially, foundation piles are used when large or high-storied buildings are constructed and when the underground strength is insufficient because of the presence of soft soil layers.

[0006] Due to an increasing concern about noises, vibrations and air pollution caused during installation of conventional foundation piles, implanting-type foundation piles have become popular in recent years. Referring to FIG. 1, a conventional implanting-type foundation pile 1 includes a tubular wall 11 with a top edge 111.

[0007] Referring to FIGS. 2-4, the foundation pile 1 is installed as follows: an implanting hole 21 is first drilled in the ground, and concrete slurry 100 is poured into the hole 21. Subsequently, the tubular wall 11 of the foundation pile 1 is lowered into the hole 21 such that the concrete slurry 100 flows into the tubular wall 11 from the bottom end thereof and fills the tubular wall 11. As the tubular wall 11 is lowered, part of the concrete slurry 100 flowing into the gap between the hole 21 and the tubular wall 11 combines with the surrounding soil, and flows back into the tubular wall 11 through the top edge 111. Therefore, an inferior-quality concrete 100 is formed within the tubular wall 11 proximate to the top edge 111. After 14 days, the concrete slurry 100 is consolidated, and the soil surrounding an upper portion of the foundation pile 1 is excavated to protrude the upper portion. The inside of the upper portion is then hollowed out from the top edge 111 to a depth of about 2 meters to remove the inferior concrete 100. Thereafter, a reinforcing steel rod 23 is threaded through a reinforcing cage 22, the reinforcing cage 22 is lowered into the tubular wall 11, and two ends of the reinforcing steel rod 23 are placed on the top edge 111 of the tubular wall 11 to hang the reinforcing steel rod 23. Finally, concrete slurry 100' is filled in the tubular wall 11 to secure the reinforcing steel rod 23 and the reinforcing cage 22 to the tubular wall 11.

[0008] The aforesaid method of implanting the foundation pile 1 advantageously reduces noises, vibration and air pollution. However, the following disadvantages are encountered in the method:

[0009] Because the inferior concrete 100' is formed in the upper portion of the foundation pile 1, it is necessary to excavate the surrounding soil to expose the upper portion of the foundation pile 1 and to remove the inferior concrete 100' from the upper portion, thereby consuming time and labor and increasing costs.

[0010] Anchorage of the reinforcing cage 22 to the foundation pile 1 is insufficient because the reinforcing steel rod 23 which carries the reinforcing cage 22 merely rests on the top edge 111 of the tubular wall 11.

[0011] The foundation pile 1 implanted into the hole 21 has inner and outer surfaces to contact against interior and exterior consolidated concrete bodies. Because no concrete part interconnects the interior and exterior concrete bodies, lateral and axial binding forces of the concrete and the foundation pile 1 are low. As a result, when a building structure supported by the foundation pile 1 encounters destructive forces, such as strong wind, earthquake, etc., the reinforcing cage 22 is prone to displace laterally or become loosened. Especially, the resistance of the foundation pile 1 against an axial pulling force is very low.

SUMMARY OF THE INVENTION

[0012] An object of the present invention is to provide a foundation pile that can effectively reduce the installation cost and that possesses high transverse and axial bearing forces and high anchoring effect.

[0013] Another object of the present invention is to provide an improved method of installing a foundation pile.

[0014] According to one aspect of the present invention, a foundation pile comprises a tubular wall having top and bottom ends and defining an inner space, a top cap covering the top end of the tubular wall, a partition plate disposed transversely inside the tubular wall below the top cap and dividing the inner space into an upper space between the top cap and the partition plate, and a lower space below the partition plate and opening at the bottom end, two opposite fixing holes extending radially through the tubular wall and communicating with the upper space, and a plurality of pressure release holes extending radially through the tubular wall and communicated with the lower space.

[0015] According to another aspect of the invention, a method of installing a foundation pile, which includes a tubular wall, a top cap covering a top end of the tubular wall, a partition plate disposed inside the tubular wall and dividing the tubular wall into an upper space between the top cap and the partition plate, and a lower space below the partition plate. The method comprises: drilling a hole in the ground; pouring a concrete slurry into the hole; lowering the foundation pile into the hole and into the concrete slurry in such a manner that the upper space of the foundation pile is disposed above the surface of the ground; removing the top cap of the foundation pile to open the upper space and placing a reinforcing cage into the upper space; anchoring the reinforcing cage to the tubular wall; and filling concrete slurry in the upper space to secure the fixing member and the reinforcing cage to the tubular wall.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiments with reference to the accompanying drawings, of which:

[0017] FIG. 1 is a sectional view illustrating a conventional foundation pile for a building construction;

[0018] FIG. 2 illustrates consecutive operating steps employed in a conventional method for installing the foundation pile of FIG. 1;

[0019] FIG. 3 is a fragmentary enlarged sectional view illustrating a reinforcing cage of FIG. 2;
FIG. 4 is a fragmentary enlarged sectional view illustrating a final stage of the foundation pile of FIG. 2;
FIG. 5 is a side sectional view illustrating a foundation pile according to a first preferred embodiment of the present invention;
FIG. 6 is a fragmentary enlarged sectional view of the foundation pile of FIG. 5;
FIG. 7 is a flow diagram illustrating a method of installing a foundation pile according to the first preferred embodiment of the present invention;
FIGS. 8A–8F illustrate consecutive operating steps employed in the method of the preferred embodiment;
FIG. 9 is a fragmentary enlarged sectional view for illustrating a reinforcing cage of the first preferred embodiment; and
FIG. 10 is a side sectional view illustrating the second preferred embodiment of a foundation pile according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before the present invention is described in greater detail with reference to the accompanying preferred embodiments, it should be noted herein that like elements are denoted by the same reference numerals throughout the disclosure.

Referring to FIGS. 5 and 6, a foundation pile 3 according to the first preferred embodiment of the present invention includes a tubular wall 32; a top cap 31 covering the top end of the tubular wall 32; a partition plate 33 disposed transversely inside the tubular wall 32 below the top cap 31; two opposite fixing holes 34 extending radially through the tubular wall 32; and a plurality of pressure release holes 35 extending radially through the tubular wall 32.

The tubular wall 32 has top and bottom ends and cooperates with the top cap 31 to define an inner space 36. The partition plate 33 divides the inner space 36 into an upper space 361 between the top cap 31 and the partition plate 33, and a lower space 363 below the partition plate 33 and formed with an opening 362 at the bottom end. A distance between the partition plate 33 and the top cap 31 is smaller than a distance between the partition plate 33 and the bottom end. In this embodiment, the distance between the partition plate 33 and the top cap 31 is about 2000 mm.

The fixing holes 34 are communicated with the upper space 361, and the pressure release holes 35 are communicated with the lower space 363. In this embodiment, pairs of the pressure release holes 35 are formed in the tubular wall 32 at intervals along the axial direction of the tubular wall 32. The pressure release holes 35 in each pair are diametrically opposite to each other.

Referring to FIGS. 7, and 8A–8F, a method of installing the foundation pile 3 comprises the following steps: drilling (step 41); pouring concrete (step 42); lowering the foundation pile (step 43); opening the foundation pile (step 44); anchoring a reinforcing cage (step 45); and filling concrete (step 46).

In the step 41, a hole 21 is drilled in the ground as shown in FIG. 8A. In the step 42, concrete slurry 52 is poured into the hole 21 as shown in FIG. 8B. In step 43, the foundation pile 3 is lowered into the hole 51 and into the concrete slurry 52 such a manner that the upper space 361 of the foundation pile 3 is disposed above the surface of the ground. At this stage, the concrete slurry 52 flows into the lower space 363 from the opening 362, and flows outwardly through the pressure release holes 35, as shown in FIG. 8C. The partition plate 33 stops the concrete slurry 52 from flowing into the upper space 361. In the meanwhile, the pressure release holes 35 discharge the air in the lower space 363 to reduce pressure inside the tubular wall 32. As such, when the concrete slurry 52 flows into the tubular wall 32 from the opening 362, the concrete slurry 52 will not entrain air and water and will not retard the consolidation of the concrete.

In step 44, the top cap 31 of the foundation pile 3 is removed to open the upper space 361, and a reinforcing cage 53 is placed into the upper space 361 as shown in FIG. 8D. Referring to FIGS. 8E and 9, in step 45, the reinforcing cage 53 is anchored to the tubular wall 32 by extending a fixing member 54 through the reinforcing cage 53 and by inserting two ends of the fixing member 54 into two fixing holes 34 formed in the tubular wall 32. In step 46, concrete slurry 52 is filled in the upper space 361 to secure the fixing member 54 and the reinforcing cage 53 to the tubular wall 32.

According to the preferred embodiment, the fixing member 54 used in the step 45 may be a stiffened steel rod, and the concrete slurry 52 used in the step 42 and the concrete slurry 52 used in the step 46 may include expansive cement.

In the present invention, because the upper space 361 of the foundation pile 3 is disposed above the surface of the ground during the lowering of the foundation pile 3, and because the partition plate 33 prevents the concrete slurry 52 from flowing into the upper space 361, the excavating step employed in the conventional method (see FIG. 2) is not needed in the invention simplifies the installation operations, conventional method, the method of the present invention simplifies the installation operations, saves time and labor, and reduces costs.

In addition, since the fixing member 54 is fixed inside the tubular wall by virtue of the two fixing holes 34, the fixing member 54 together with the reinforcing cage 53 can be embedded in the consolidated concrete body in the tubular wall 32, thereby improving anchorage of the reinforcing cage 53 to the tubular wall 32 and the concrete. Accordingly, the resistance of the reinforcing cage 53 against an upward axial pulling force can be increased, the lateral binding forces between the reinforcing cage 53 and the foundation pile 3 are increased, and an incidence of loosening the reinforcing cage 53 due to lateral and axial destructive forces can be reduced.

Furthermore, because the concrete slurry 52 flows through the pressure release holes 35 from the lower space 363 and is consolidated in the pressure release holes 35, anchorage between the concrete and the foundation pile 3 is increased, thus improving lateral and axial binding forces between the foundation pile 3 and the concrete.

Referring to FIG. 10, the second preferred embodiment of this invention is generally identical to the first preferred embodiment, but differs in that the foundation pile 3 further includes two temporary blocking pieces 37 removably plugged into the fixing holes 34, respectively. During the step of lowering the foundation pile 43, the blocking pieces 37 prevent the soil surrounding the hole 51 from entering the upper space 361 through the fixing holes 34 so that the concrete slurry 52 filled in the upper space 361 will not be degraded by the surrounding soil.

While the present invention has been described in connection with what is considered the most practical and preferred embodiments, it is understood that this invention is not limited to the disclosed embodiments but is intended to cover various arrangements within the spirit and
scope of the broadest interpretation so as to encompass all such modifications and equivalent arrangements.

What is claimed is:

1. A foundation pile for a building construction, comprising:
   - a tubular wall having top and bottom ends and defining an inner space;
   - a top cap covering said top end of said tubular wall;
   - a partition plate disposed transversely inside said tubular wall below said top cap and dividing said inner space into an upper space between said top cap and said partition plate, and a lower space below said partition plate and opening at said bottom end;
   - two opposite fixing holes extending radially through said tubular wall and communicating with said upper space; and
   - a plurality of pressure release holes extending radially through said tubular wall and communicating with said lower space.

2. The foundation pile of claim 1, further comprising two blocking pieces removably plugged into said fixing holes, respectively.

3. The foundation pile of claim 1, wherein a distance between said partition plate and said top cap is smaller than a distance between said partition plate and said bottom end.

4. The foundation pile of claim 3, wherein a distance between said partition plate and said top cap is about 2000 mm.

5. A method of installing a foundation pile, which includes a tubular wall, a top cap covering a top end of the tubular wall, a partition plate disposed inside the tubular wall and dividing the tubular wall into an upper space between the top cap and the partition plate, and a lower space below said partition plate, the method comprising:
   - drilling a hole in the ground;
   - pouring a concrete slurry into the hole;
   - lowering the foundation pile into the hole and into the concrete slurry in such a manner that the upper space of the foundation pile is disposed above the surface of the ground;
   - removing the top cap of the foundation pile to open the upper space and placing a reinforcing cage into the upper space;
   - anchoring the reinforcing cage to the tubular wall; and
   - filling concrete slurry in the upper space to secure the fixing member and the reinforcing cage to the tubular wall.

6. The method of claim 5, wherein the step of anchoring includes the step of threading a fixing member through the tubular wall and the reinforcing cage and inserting two ends of the fixing member respectively into two aligned fixing holes formed in the tubular wall.

7. The method of claim 6, wherein the fixing member is a stiffened steel rod.

8. The method of claim 5, wherein the concrete slurry includes expansive cement.