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(54) GROUTING CONSOLIDATION METHOD FOR FULL CASING BOREHOLE GUIDE PREFABRICATED PILE AND PREFABRICATED PILE THEREFOR

(57) A grouting consolidation method for a full casing borehole guide prefabricated pile, comprising the following steps: S1, driving a drilling rig carrying a casing (1) to perform borehole construction, the borehole construction being performed to a preset hole depth to form a borehole (2); S2. the casing (1) being housed in the borehole (2); S3. implanting a prefabricated pile (4) into the borehole (2) so that the prefabricated pile (4) reaches a hole bottom of the borehole (2); S4. injecting a slurry (3) into the borehole (2); S5. pulling out the casing (1) so that the prefabricated pile (4) and an inner cavity of the borehole (2) are fixed and cemented into an integrated structure. Also provided is a prefabricated pile, comprising a pile body and a grouting channel (5) provided on the pile body, wherein a liquid inlet end (11) of the grouting channel (5) extends out from an upper end surface of the pile body and a liquid outlet end (12) of the grouting channel (5) extends out from a lower end surface of the pile body and/or a side surface of the pile body.

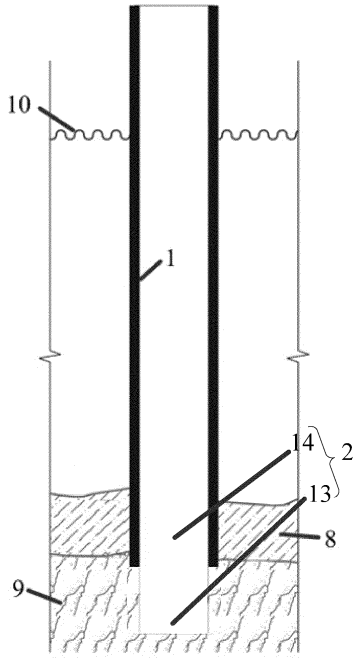

Figure 1

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Description

TECHNICAL FIELD

[0001] The present application relates to the technical field of foundations, in particular to grouting consolidation method for full casing borehole guide prefabricated pile and prefabricated pile therefor.

BACKGROUD

[0002] At present, in the field of foundation engineering technology of water projects, in particular in the field of marine engineering technology, the pile foundations in rivers, lakes and seas are mostly cast-in-place bored pile or hammered steel pipe pile. The most common construction scheme and method for cast-in-place bored pile is called cofferdam-built island construction or the construction work is completed with the aid of a steel casing. Cofferdam-built island construction is also called island construction with filling center. In order to solve the difficulty in marine environment construction, it is necessary to fill the area enclosed by the cofferdam with soil, sand and gravel, and then carry out a drilling and grouting process. Moreover, after the cast-in-place bored pile construction is completed, the cofferdam-built island needs to be demolished, resulting in a huge amount of construction work, which causes the problems of long engineering period and high engineering cost. Similarly, as the hammered steel pipe piles are constructed by hammering to sink into the foundation in the water area, when the hammered steel pipe piles are hammered to reach a hard base rock, the ends of the hammered steel pipe piles will be curled or even unable to be driven into the base rock, and as the steel pipe of the hammered steel pipe pile can't be taken out, it not only results in the problem that the steel pipe is prone to be corroded, but also the problem of high construction cost and large amount of construction work for performing the above construction.

SUMMARY

[0003] Therefore, the present application is intended to provide a grouting consolidation method for full casing borehole guide prefabricated pile and prefabricated pile therefor so as to solve the problem in prior art that cast-in-place bored pile foundation construction has a large amount of construction work, long construction period and high construction cost in foundations construction in water area with various stratum conditions, especially in the foundation construction in marine engineering. The application provides a grouting consolidation method for full casing borehole guide prefabricated pile, which can be used in the foundation construction of water projects, and comprises the following steps:

S1. driving a drilling rig carrying a casing to perform borehole construction to a preset hole depth to form a borehole;

S2. housing the casing in the borehole;

S3. implanting a prefabricated pile into the borehole so that the prefabricated pile reaches a hole bottom of the borehole;

S4. injecting a slurry into the borehole;

S5. pulling out the casing so that the prefabricated pile and an inner cavity of the borehole are fixed and cemented into an integrated structure.

[0004] The implanting a prefabricated pile into the borehole so that the prefabricated pile reaches a hole bottom of the borehole in step S3 comprises the following steps: pre-injecting a slurry into the borehole; before solidification of the slurry, the prefabricated pile is implanted into the borehole to reach the hole bottom of the bore.

[0005] The prefabricated pile is prefabricated with a grouting channel for injecting the slurry into the borehole, the pulling out the casing in step S5 comprises continuously grouting into the borehole through the grouting channel on the prefabricated pile during the process of pulling out the casing, and/or the injecting the slurry into the borehole in step S4 comprises grouting into the borehole through the grouting channel on the prefabricated pile before pulling out the casing.

[0006] The grouting channel comprises a first grouting channel on a bottom surface of the prefabricated pile; the pulling out the casing in step S5 comprises continuously grouting into the borehole through the first grouting channel during the process of pulling out the casing, and/or the injecting the slurry into the borehole in step S4 comprises grouting into the borehole through the first grouting channel before pulling out the casing.

[0007] The grouting channel comprises a second grouting channel located at a side of the prefabricated pile for grouting between the prefabricated pile and the bore hole; and

the method further comprises a step S6, grouting between the prefabricated pile and the bore hole through the second grouting channel.

[0008] During the foundation construction of water projects with a water area having a base rock layer at a bottom thereof,

the driving a drilling rig carrying a casing to perform borehole construction to a preset hole depth in step S1 comprises sinking the casing to the base rock layer; sinking a drilling bit of the drilling rig to the base rock layer through the inner cavity of the casing, and drilling the base rock layer to form a base rock borehole in the base rock layer; and

the removing the drilling bit of the drilling rig from the base rock borehole, and housing the casing in the base rock borehole in step S2 comprises removing the drilling bit of the drilling rig from the base rock borehole and the

casing sequentially, and a lower end of the casing entering an opening edge of the inner cavity of the base rock borehole; and
the borehole comprises the base rock borehole.
during the foundation construction of water projects with a water area having a bottom comprising a loose layer and a base rock layer sequentially from up to down,
the driving a drilling rig carrying a casing to perform borehole construction to a preset hole depth in step S1 comprises:

sinking the casing to the loose layer, and the drilling rig drilling the loose layer to drive the casing through the loose layer to form a loose layer borehole;
removing mud and sand from the casing;
sinking the drilling bit of the drilling rig to the base rock layer through the inner cavity of the casing, and drilling the base rock layer to form a base rock borehole in the base rock layer;
the removing the drilling bit of the drilling rig from the borehole, and housing the casing in the borehole in step S2 comprises removing the drilling bit of the drilling rig from the base rock borehole and the casing sequentially, and a lower end of the casing entering an opening edge of the inner cavity of the base rock borehole; and
the borehole comprises the loose layer borehole and the base rock borehole.

[0009] During the foundation construction of water projects with a water area having a loose layer at a bottom thereof,
the driving a drilling rig carrying a casing to perform borehole construction to a preset hole depth in step S1 comprises sinking the casing to the loose layer, and the drilling rig drilling the loose layer to form a loose layer borehole to bring the casing into the loose layer; removing mud and sand from the casing.

[0010] An upper end of the prefabricated pile is located above a water surface of the water area, and /or an upper end of the prefabricated pile is located below a water surface of the water area.

[0011] The slurry comprises cement slurry and/or mortar and/or chemical slurry.

[0012] A prefabricated pile, comprising

a pile body, and

a grouting channel, arranged on the pile body, wherein a liquid inlet end of the grouting channel extends out of an upper end surface of the pile body, and a liquid outlet end of the grouting channel extends out of a lower end surface of the pile body and/or a side surface of the pile body.

[0013] The pile body is a reinforced concrete prefabricated pile, and the grouting channel is a grouting pipe prefabricated on a steel cage of the pile body.

[0014] The technical scheme of the present application has the following advantages:

1. The application provides a grouting consolidation method for full casing borehole guide prefabricated pile, which can be used in the foundation construction of water projects, and comprises the following steps:
S 1. driving a drilling rig carrying a casing to perform borehole construction to a preset hole depth; S2. housing the casing in the borehole; S3. implanting a prefabricated pile into the borehole so that the prefabricated pile reaches a hole bottom of the borehole; S4. injecting a slurry into the borehole; S5. pulling out the casing so that the prefabricated pile and an inner cavity of the borehole are fixed and cemented into an integrated structure.
In order to adapt to the stratums of various water projects, especially the marine engineering environment, wherein the construction of the marine engineering is performed above the surface of rivers and lakes, the present application firstly provide a casing to cooperate to drill holes, then guides the prefabricated pile into the hole bottom of the borehole, and finally injects a slurry to solidify to realize the construction of water area stratums. Since the foundation of water project has high requirements for construction intensity, casing can be used to assist drilling to adapt to different stratum structures underwater. Guiding prefabricated piles into the bottom of the borehole can effectively ensure a stable and reliable foundation construction of water projects. Through the above methods, the construction of pile foundations in rivers, lakes and seas and other water areas can be realized. Since the steps of cofferdam-built island construction and demolition thereof can be omitted, and the above casing can be reused, the problem of large amount of engineering, long engineering period, and high engineering cost in the cast-in-place bored pile foundation construction can be solved, while ensuring the construction intensity.

2. In the grouting consolidation method for full casing borehole guide prefabricated pile provided by the present application, the implanting a prefabricated pile into the borehole so that the prefabricated pile reaches a hole bottom of the borehole in step S3 comprises the following steps: pre-injecting a slurry into the borehole; before solidification of the slurry, the prefabricated pile is implanted into the borehole to reach the hole bottom of the bore. By pre-injecting the slurry into the borehole before implanting the prefabricated pile in the borehole, the prefabricated pile and the slurry in the borehole can be fully cemented. Moreover, a descending impact force of the prefabricated piles can also effectively cause the slurry to enter the bottom of the borehole, thereby forming a larger and solid bottom-fixing head of the borehole 2.

3. In the grouting consolidation method for full casing borehole guide prefabricated pile provided by the present application, the prefabricated pile is prefabricated with a grouting channel for injecting the slurry into the borehole, and the pulling out the casing in step S5 comprises continuously grouting into the borehole through the grouting channel on the prefabricated pile during the process of pulling out the casing, and during this process, the slurry can flow into the borehole simply and conveniently through the grouting channel of the prefabricated pile to fill the gap generated in this process. In addition, through the above method, the prefabricated pile and the stratums around the borehole can be tightly cemented and fixed to be adapted to various stratums, but also make the pulling of the casing smoother, and reduce operation difficulty, thereby solving the problem that the existing cast-in-place bored pile foundation in water has large amount of engineering work, long engineering period and high engineering cost.

The injecting the slurry into the borehole in step S4 comprises grouting into the borehole through the grouting channel on the prefabricated pile before pulling out the casing.

The operation of grouting into the borehole through the grouting channel on the prefabricated pile before pulling out the casing or directly injecting the slurry into the borehole is simple and convenient, which can make the prefabricated pile and the stratum around the borehole 2 tightly cemented and fixed together to form a prefabricated pile foundation, thereby improving a connection strength of the prefabricated pile, soil, and sand in the marine engineering environment.

4. In the grouting consolidation method for full casing borehole guide prefabricated pile provided by the present application, the grouting channel comprises a first grouting channel on a bottom surface of the prefabricated pile. Through setting a grouting channel in the bottom surface and side surface of the prefabricated pile respectively, so that the slurry can be injected into the borehole from the bottom surface of the prefabricated pile, such that the slurry can more evenly and fully fill a gap between the prefabricated pile and the borehole, and the prefabricated pile and the stratums around the borehole 2 can be tightly cemented and fixed together to form a prefabricated pile foundation.

5. In the grouting consolidation method for full casing borehole guide prefabricated pile provided by the present application, during the foundation construction of water projects with a water area having a base rock layer at a bottom thereof, the driving a drilling rig carrying a casing to perform borehole construction to a preset hole depth in step S1 comprises the following steps: sinking the casing to the base rock layer, sinking a drilling bit of the drilling rig to the base rock layer through the inner cavity of the casing, and drilling the base rock layer to form a base rock borehole in the base rock layer; the removing the drilling bit of the drilling rig from the base rock borehole, and housing the casing in the base rock borehole in step S2 comprises removing the drilling bit of the drilling rig from the base rock borehole and the casing sequentially, and a lower end of the casing entering an opening edge of the inner cavity of the base rock borehole; and the borehole comprises the base rock borehole.

The drilling bit of the drilling rig passes through the casing to drill the base rock layer, which can effectively solve the problem that the base rock layer is difficult to be constructed in the construction process of the water area with the base rock layer at the bottom thereof. Moreover, by pre-injecting the slurry into the base rock borehole, and then sinking the prefabricated piles into the base rock borehole, the descending impact effect of the prefabricated piles can effectively make more slurry to fully filtrate into and consolidate with the base rock layer, thus the slurry fully fills the bottom and side part of the base rock layer.

6. In the grouting consolidation method for full casing borehole guide prefabricated pile provided by the present application, during the foundation construction of water projects with a water area having a bottom comprising a loose layer and a base rock layer sequentially from up to down,

the driving a drilling rig carrying a casing to perform borehole construction to a preset hole depth in step S1 comprises: sinking the casing to the loose layer, and the drilling rig drilling the loose layer to drive the casing through the loose layer to form a loose layer borehole, removing mud and sand from the casing, sinking the drilling bit of the drilling rig to the base rock layer through the inner cavity of the casing, and drilling the base rock layer to form a base rock borehole in the base rock layer; the removing the drilling bit of the drilling rig from the borehole, and housing the casing in the borehole in step S2 comprises, removing the drilling bit of the drilling rig from the base rock borehole and the casing sequentially, and a lower end of the casing entering an opening edge of the inner cavity of the base rock borehole; and the borehole comprises the loose layer borehole and the base rock borehole.

[0015] Corresponding to the construction process of water project with water area having the loose layer and base rock layer from top to bottom thereof, the loose layer is firstly drilled by the drilling bit of the drilling rig, and then the mud and sand is discharged; then, the base rock layer is drilled by a drilling bit passing through the casing,

which effectively solves the problem of the construction difficulty of the above water area caused by the loose layer and the base rock layer.

[0016] Moreover, the base rock layer and loose layer are filled and fixed respectively through the following steps: pre-injecting the slurry into a base rock borehole, and then filling the base rock borehole by sinking the prefabricated pile into the base rock borehole; then during the process of lifting the casing, the slurry is continuously injected into the loose layer through the grouting channel on the prefabricated pile.

[0017] Drilling in the base rock is performed in a manner of pre-injecting slurry and then implanting the prefabricated pile, which can effectively make the slurry cemented and fixed with the base rock borehole with sufficient time and the slurry can infiltrate into the base rock more fully under the effect of the impact force of the prefabricated pile. The loose layer is injected with the slurry during the casing is lifted, which can be used to effectively fill the gap between the prefabricated pile and the casing to complete the above grouting work, so that the prefabricated pile and the stratums around the borehole in the loose layer can be cemented and fixed together with the slurry.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In order to more clearly describe the technical solutions in the specific embodiments of the present application or in the prior art, hereinafter the accompanying drawings required to be used in the description of the specific embodiments or the prior art will be briefly introduced. Apparently, the accompanying drawings described below are only directed to some embodiments of the present application, and for those skilled in the art, without expenditure of creative labor, other drawings can be derived on the basis of these accompanying drawings.

Figure 1 is a schematic view showing the installation step of a full casing in a water area with loose layer and base rock layer provided by the present application;

Figure 2 is a schematic view showing the step of pre-injecting the slurry to the base rock layer in the water area with loose layer and base rock layer provided by the present application;

Figure 3 is a schematic view showing the step of sinking the prefabricated pile to a bottom of the pre-injected borehole in a water area with loose layer and base rock layer provided by the present application;

Figure 4 is a schematic view showing the step of taking out a full casing in a water area with loose layer and base rock layer provided by the present application;

Figure 5 is a schematic structural view showing a connection structure between the prefabricated pile and a bottom of the water area with a loose layer and a base rock layer provided by the present application after grouting consolidation process for full casing borehole guide prefabricated pile is completed;

Figure 6 is a schematic structural view showing a prefabricated pile that sinks to the bottom of the borehole provided by the present application;

Figure 7 is a schematic view showing a connection structure between the prefabricated pile and the foundation of the environment when the full casing is taken out after grouting consolidation process for full casing borehole provided by the present application.

Reference numerals:

[0019] 1- casing; 2- borehole; 3- slurry; 4- prefabricated pile; 5- grouting channel; 6-first grouting channel; 7- second grouting channel; 8- loose layer; 9- base rock layer 10- water surface; 11-liquid inlet end; 12- liquid outlet end; 13- base rock borehole; 14- loose layer borehole.

DETAILED DESCRIPTION

[0020] A clear and complete description of the technical solutions in the present application will be given below, in conjunction with the accompanying drawings in the embodiments of the present application. Apparently, the embodiments described below are a part, but not all, of the embodiments of the present application. All of other embodiments, obtained by those of ordinary skill in the art based on the embodiments of the present application without any creative effort, fall into the protection scope of the present application.

[0021] In the description of the present application, it needs to be noted that, the terms such as "center", "on/above", "below", "left", "right", "vertical", "horizontal", "inside", "outside" refer to the orientation or position relation based on the illustration of the drawings, and merely for facilitating and simplifying the description of the present application, but not indicating or implying that the apparatus or components must have a specific orientation, or a specific configuration and operation. Thus, it should be understood as a limitation to the present application. In addition, the terms such as "first", "second", "third" are merely for the purpose of description, but should not be understood as an indication or implication of relative importance.

[0022] In the description of the present application, it needs to be noted that, unless specifically defined or restricted otherwise, terms "installation", "connection", "connect" should be broadly construed, for example, they may be fixed connection or detachable connection or in-

tegral connection; mechanical connection or electrical connection; direct connection, or indirect connection via an intermediate medium, or internal communication between two units; wireless connection or wired connection. For those skilled in the art, the specific meaning of the aforementioned terms in the present application can be understood according to specific situations thereof.

[0023] Furthermore, the technical features which the embodiments of the present application provided below refer to can be combined with each other as long as no conflict is constituted.

Example 1

[0024] In Example 1, it provides a grouting consolidation method for full casing borehole guide prefabricated pile. The engineering environment for construction is shown in Figures 1 to 7. During a construction process in the water area having loose layer 8 and base rock layer 9 from top to bottom sequentially at the bottom thereof, the grouting consolidation method for full casing borehole guide prefabricated pile comprises the following steps:

S1, sinking the casing 1 to the loose layer 8, and the drilling rig drilling the loose layer 8 to drive the casing 1 through the loose layer 8 to form a loose layer borehole 14;

removing water, mud and sand from the casing 1;

sinking the drilling bit of the drilling rig to the base rock layer through the inner cavity of the casing 1, and drilling the base rock layer to form a base rock borehole 13 in the base rock layer;

S2, removing the drilling bit of the drilling rig from the base rock borehole 13 and the casing 1 sequentially, and a lower end of the casing 1 entering an opening edge of the inner cavity of the base rock borehole 13 such that an end of the casing 1 is sleeved with the opening edge of the base rock borehole 13;

S3, pre-injecting a slurry into the borehole 2; before solidification of the slurry, implanting the prefabricated pile 4 into the borehole 2 to reach the hole bottom of the bore 2; and locating an upper end of the prefabricated pile 4 above the water surface of the water area, so as to facilitate the grouting through a grouting channel 5 on the prefabricated pile 4 by a construction personnel;

S4, lifting the casing 1, and during the lifting of the casing 1, continuously injecting the slurry into the base rock borehole 13 and the loose layer borehole 14 through the grouting channel 5 on the prefabricated pile 4; the grouting channel 5 comprising a first grouting channel 6 on a bottom surface of the prefabricated pile 4, during the process of pulling out the casing 1, continuously injecting the slurry into the loose layer borehole 14 through the first grouting channel 6, so that the prefabricated piles 4 is respectively fixed and cemented with a hole wall and bottom of the base rock borehole 13 and a hole wall of the loose layer borehole 14 into an integrated structure;

S5, injecting the slurry between the prefabricated pile 4 and the stratums through the second grouting channel 7 to achieve an effect of repeatedly strengthening the prefabricated pile 4; corresponding to the construction process of water project with a water area having the loose layer 8 and base rock layer 9 from top to bottom thereof, drilling the loose layer 8 firstly by the drilling bit of the drilling rig, and then discharging the mud and sand; drilling the base rock layer 9 by the drilling bit passing through the casing 1, which effectively solves the problem of the construction difficulty of the above water area caused by the loose layer 8 and the base rock layer 9. Moreover, the base rock layer 9 and loose layer 8 is filled and fixed respectively through the following steps: pre-injecting the slurry into a base rock borehole 13, and then filling the base rock borehole 13 by sinking the prefabricated pile 4 into the base rock borehole 13; then during the process of lifting the casing 1, continuously injecting the slurry into the loose layer 8 through the grouting channel 5 of the prefabricated pile. The base rock borehole 13 in the base rock is performed in a manner of pre-injecting slurry and then implanting the prefabricated pile 4, which can effectively make the slurry cemented and fixed with the base rock borehole 13 with sufficient time and the slurry can fully infiltrate into the base rock 9 under the effect of the impact force of the prefabricated pile 4. The loose layer 8 is injected with the slurry during the casing 1 is lifted, which can be used to effectively fill the gap between the prefabricated pile 4 and the casing 1 to complete the above grouting work, so that the prefabricated pile 4 and the stratums around the loose layer borehole 14 can be cemented and fixed together with the slurry.

[0025] Furthermore, through setting a grouting channel in the bottom surface and side surface of the prefabricated pile 4 respectively, so that the slurry can be injected into the base rock borehole 13 and loose layer borehole 14 from the bottom surface and side surface of the prefabricated pile 4 respectively, such that the slurry can more evenly and fully fill in a gap between the prefabricated pile 4 and the base rock borehole 13, and a gap between the prefabricated pile 4 and the loose layer borehole 14; and the prefabricated pile 4 and the stratums around the borehole 2 can be tightly cemented and fixed together to form a prefabricated pile 4 foundation. In addition, the present application firstly provide a casing 1 for cooperation wth drilling holes, then guides the prefabricated pile 4 into the stratums of the borehole 2, and

finally injects a slurry 3 for consolidation to realize the construction of water area stratums. Through the above methods, the construction of pile foundations in rivers, lakes and seas and other water areas can be realized. Since the steps of cofferdam-built island construction and demolition thereof can be omitted, and the above casing 1 can be reused, the problem of large amount of engineering, long engineering period, and high engineering cost in the cast-in-place bored pile foundation construction can be solved, while ensuring the construction intensity. In addition, in this application, a certain volume of slurry 3 is injected into the steel casing 1 before the steel casing 1 is pulled out, and the slurry 3 can permeate a soil layer or sand layer at the bottom of the steel casing 1 to make the stratum at bottom of the borehole 2 and the bottom of the prefabricated pile 4 closely cemented together. Thus, a solid fixed structure after solidification can be formed at the bottom of the borehole 2.

[0026] Moreover, when lifting the steel casing 1, the slurry 3 can be tightly cemented and fixed with the stratums around the borehole 2, such that the prefabricated pile 4 and the stratums around the sidewall of the borehole 2 will be tightly cemented and fixed together to form a prefabricated pile foundation, which in turn, improves the connection strength of the prefabricated pile 4 with the soil and sand in the foundation environment or the marine engineering environment.

[0027] In Example 1, a prefabricated pile comprises:

a pile body being a reinforced concrete prefabricated pile, and

a grouting channel 5, arranged on the pile body, wherein a liquid inlet end 11 of the grouting channel 5 extends out of an upper end surface of the pile body, and a liquid outlet end 12 of the grouting channel 5 extends out of a lower end surface of the pile body and/or a side surface of the pile body.

[0028] In Example 1, the casing 1 is made of metal, and the bottom end of the casing 1 has a tooth-like structure for cutting the soil.

[0029] Certainly, the position of the upper end of the prefabricated pile 4 is not specifically limited in the application. In other Examples, the upper end of the prefabricated pile 4 is located below the water surface of the water area.

[0030] Certainly, the material and composition of the slurry 3 is not specifically limited in the application. In other Examples, the slurry 3 can also be mortar or chemical slurry, as well as two or three of cement slurry, mortar slurry and chemical slurry. mixture.

[0031] Certainly, the present application does not specifically limit the connection manner of the grouting channel 5 and the steel cage. In other Examples, the grouting channel 5 is preset on the steel cage.

[0032] Certainly, the present application does not specifically limit the arrangement manner and number of grouting channels on the prefabricated pile 4. In other Examples, the prefabricated pile 4 only comprises a plurality of first grouting channels 6 located on the bottom surface of the prefabricated pile 4, or the prefabricated pile 4 only comprises a plurality of second grouting channels 7 on the side surface of the prefabricated pile 4.

[0033] Certainly, the application of the present application does not specifically limit the function of the second grouting channel 7. In other Examples, in the process of pulling out the casing 1, the slurry can be continuously injected into the borehole 14 in the loose layer through the first grouting channel 6 and the second grouting channel 7.

Example 2

[0034] Example 2 differs from Example 1 in that the grouting consolidation method for full casing borehole guide prefabricated pile in the engineering construction environment of the water area having base rock 9 at the bottom thereof, comprise the following steps:

S1, sinking the casing 1 to the base rock layer; sinking a drilling bit of the drilling rig to the base rock layer through the inner cavity of the casing 1, and drilling the base rock layer to form a base rock borehole 13 in the base rock layer;

S2: the lower end of the casing 1 entering an opening edge of the inner cavity of the base rock borehole 13, so that an end of the casing 1 is sleeved with the opening edge of the base rock borehole 13, and the drilling bit of the drilling rig is sequentially removed from the base rock bore 13 and the casing 1;

S3, pre-injecting a slurry 3 into the borehole 2; before solidification of the slurry 3, the prefabricated pile 4 is implanted into the base rock borehole 13 to reach the hole bottom thereof;

S4. pulling out the casing 1 so that the inner cavity of the prefabricated pile 4 and the borehole 2 are fixed and cemented into an integrated structure.

[0035] In this Example, the drilling bit of the drilling rig passes through the casing 1 to drill the base rock layer 9, which can effectively solve the problem that the base rock layer 9 is difficult to be constructed during the construction of the water area with the base rock layer 9 at the bottom thereof. Moreover, by pre-injecting the slurry 3 into the base rock borehole 13, and then sinking the prefabricated pile 4 into the base rock borehole 13, more slurry 3 can effectively infiltrate into and consolidate the rock layer 9 through a descending impact of the prefabricated pile 4 such that the slurry 3 can fully fill in the bottom and side part of the base rock layer 9.

Example 3

[0036] Example 3 differs from Example 1 in that the grouting consolidation method for full casing borehole guide prefabricated pile in the engineering construction environment of the water area having a loose layer 8 at the bottom thereof, comprise the following steps:

S1, sinking a casing 1 to the loose layer 8, and drilling the loose layer 8 to form a loose layer borehole 14 by a drilling rig which drives the casing 1 into the loose layer 8; removing the mud and sand from the casing 1;

S2, housing the casing 1 in the loose layer borehole 14;

S3, implanting the prefabricated pile 4 into the loose layer borehole 14 so that the prefabricated pile 4 reaches a bottom of the loose layer borehole 14;

S4, lifting the casing 1; and during the lifting of the casing 1, continuously injecting the slurry into the loose layer borehole 14 through the grouting channel 5 on the prefabricated pile 4; the grouting channel 5 comprising a first grouting channel 6 on a bottom surface of the prefabricated pile 4, during the process of pulling out the casing 1, continuously injecting the slurry into the loose layer borehole 14 through the first grouting channel 6, so that the prefabricated piles 4 is fixed and cemented with a hole wall and bottom of the loose layer borehole 14 to form an integrated structure.

[0037] Obviously, the above-described examples are only examples for clear illustration, but not intended to limit the examples. Other variations or modifications in the various forms can be made by those skilled in the art based on the above description. There is no need and no way to exhaust all of the examples. The obvious changes or variations derived therefrom are still within the scope of protection claimed by the present disclosure.

Claims

1. A method for grouting and consolidating a full casing borehole guide prefabricated pile, **characterized in that**,
the method is used for foundation construction of water projects and comprises the following steps:

S1. driving a drilling rig carrying a casing (1) to perform borehole construction to a preset hole depth to form a borehole (2);
S2. housing the casing (1) in the borehole (2);
S3. implanting a prefabricated pile (4) into the borehole (2) so that the prefabricated pile (4) reaches a hole bottom of the borehole (2);
S4. injecting a slurry (3) into the borehole (2);
S5. pulling out the casing (1) so that the prefabricated pile (4) and an inner cavity of the borehole (2) are fixed and cemented into an integrated structure.

2. The method according to claim 1, **characterized in that**,
the implanting a prefabricated pile (4) into the borehole (2) so that the prefabricated pile (4) reaches a hole bottom of the borehole (2) in step S3 comprises the following steps:

pre-injecting a slurry (3) into the borehole (2);
before solidification of the slurry (3), the prefabricated pile (4) is implanted into the borehole (2) to reach the hole bottom of the bore (2).

3. The method according to claim 1 or 2, **characterized in that**,

the prefabricated pile (4) is prefabricated with a grouting channel (5) for injecting the slurry (3) into the borehole (2),
the pulling out the casing (1) in step S5 comprises continuously grouting into the borehole (2) through the grouting channel (5) on the prefabricated pile (4) during the process of pulling out the casing (1), and/or
the injecting the slurry (3) into the borehole (2) in step S4 comprises grouting into the borehole (2) through the grouting channel (5) on the prefabricated pile (4) before pulling out the casing (1).

4. The method according to claim 3, **characterized in that**,

the grouting channel (5) comprises a first grouting channel (6) on a bottom surface of the prefabricated pile (4);
the pulling out the casing (1) in step S5 comprises continuously grouting into the borehole (2) through the first grouting channel (6) during the process of pulling out the casing (1), and/or
the injecting the slurry (3) into the borehole (2) in step S4 comprises grouting into the borehole (2) through the first grouting channel (6) before pulling out the casing (1).

5. The method according to claim 3 or 4, **characterized in that**,

the grouting channel (5) comprises a second grouting channel (7) located at a side of the prefabricated pile (4) for grouting between the prefabricated pile (4) and the bore hole (2); and

the method further comprises a step S6, grouting between the prefabricated pile (4) and the bore hole (2) through the second grouting channel (7).

6. The method according to any one of claims 1 to 5, **characterized in that**,

during the foundation construction of water projects with a water area having a base rock layer (9) at a bottom thereof,
the driving a drilling rig carrying a casing (1) to perform borehole construction to a preset hole depth in step S1 comprises the following steps:

sinking the casing (1) to the base rock layer;
sinking a drilling bit of the drilling rig to the base rock layer through the inner cavity of the casing (1), and
drilling the base rock layer to form a base rock borehole (13) in the base rock layer; and

the removing the drilling bit of the drilling rig from the base rock borehole (13), and housing the casing (1) in the base rock borehole (13) in step S2 comprises,

removing the drilling bit of the drilling rig from the base rock borehole (13) and the casing (1) sequentially, and a lower end of the casing (1) entering an opening edge of the inner cavity of the base rock borehole (13); and
the borehole (2) comprises the base rock borehole (13).

7. The method according to any one of claims 1 to 5, **characterized in that**

during the foundation construction of water projects with a water area having a bottom comprising a loose layer (8) and a base rock layer (9) sequentially from up to down,
the driving a drilling rig carrying a casing (1) to perform borehole construction to a preset hole depth in step S1 comprises:

sinking the casing (1) to the loose layer (8), and the drilling rig drilling the loose layer (8) to drive the casing (1) through the loose layer (8) to form a loose layer borehole (14);
removing mud and sand from the casing (1);
sinking the drilling bit of the drilling rig to the base rock layer through the inner cavity of the casing (1), and drilling the base rock layer to form a base rock borehole (13) in the base rock layer;

the removing the drilling bit of the drilling rig from the borehole (2), and housing the casing (1) in the borehole (2) in step S2 comprises,

removing the drilling bit of the drilling rig from the base rock borehole (13) and the casing (1) sequentially, and a lower end of the casing (1) entering an opening edge of the inner cavity of the base rock borehole (13); and
the borehole (2) comprises the loose layer borehole (14) and the base rock borehole (13).

8. The method according to any one of claims 1 to 5, **characterized in that**,

during the foundation construction of water projects with a water area having a loose layer (8) at a bottom thereof,
the driving a drilling rig carrying a casing (1) to perform borehole construction to a preset hole depth in step S1 comprises:

sinking the casing (1) to the loose layer (8), and the drilling rig drilling the loose layer (8) to form a loose layer borehole (14) to bring the casing (1) into the loose layer (8);
removing mud and sand from the casing (1).

9. The method according to any one of claims 6 to 8, **characterized in that**

an upper end of the prefabricated pile (4) is located above a water surface of the water area, and /or
an upper end of the prefabricated pile (4) is located below a water surface of the water area.

10. The method according to any one of claims 1 to 9, **characterized in that**
the slurry (3) comprises cement slurry and/or mortar and/or chemical slurry.

11. A prefabricated pile, comprising

a pile body, and
a grouting channel (5), arranged on the pile body, wherein a liquid inlet end (11) of the grouting channel (5) extends out of an upper end surface of the pile body, and a liquid outlet end (12) of the grouting channel (5) extends out of a lower end surface of the pile body and/or a side surface of the pile body.

12. The prefabricated pile according to claim 11, **characterized in that**,
the pile body is a reinforced concrete prefabricated

pile, and the grouting channel (5) is a grouting pipe prefabricated on a steel cage of the pile body.

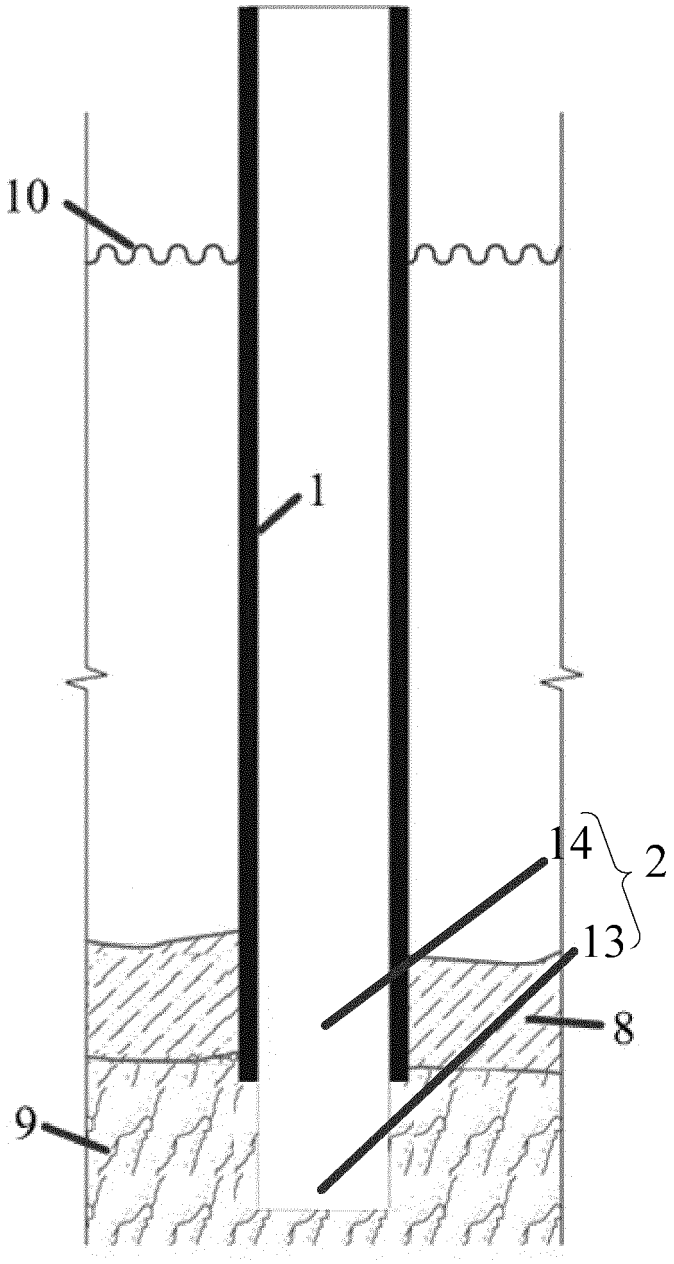

Figure 1

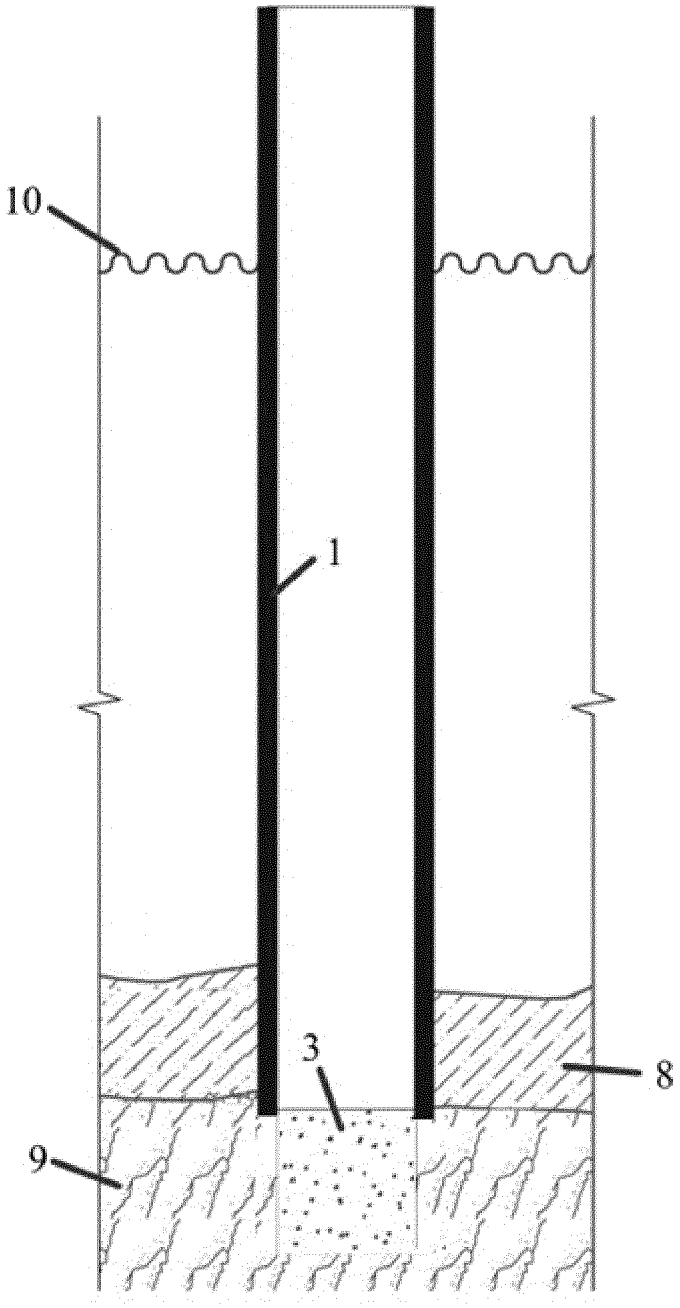

Figure 2

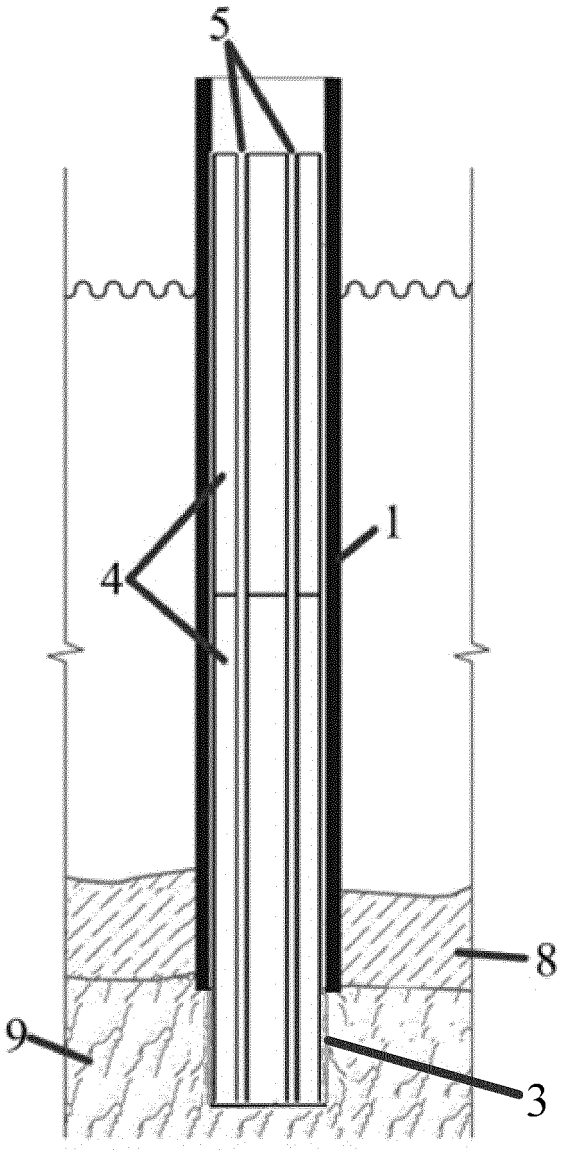

Figure 3

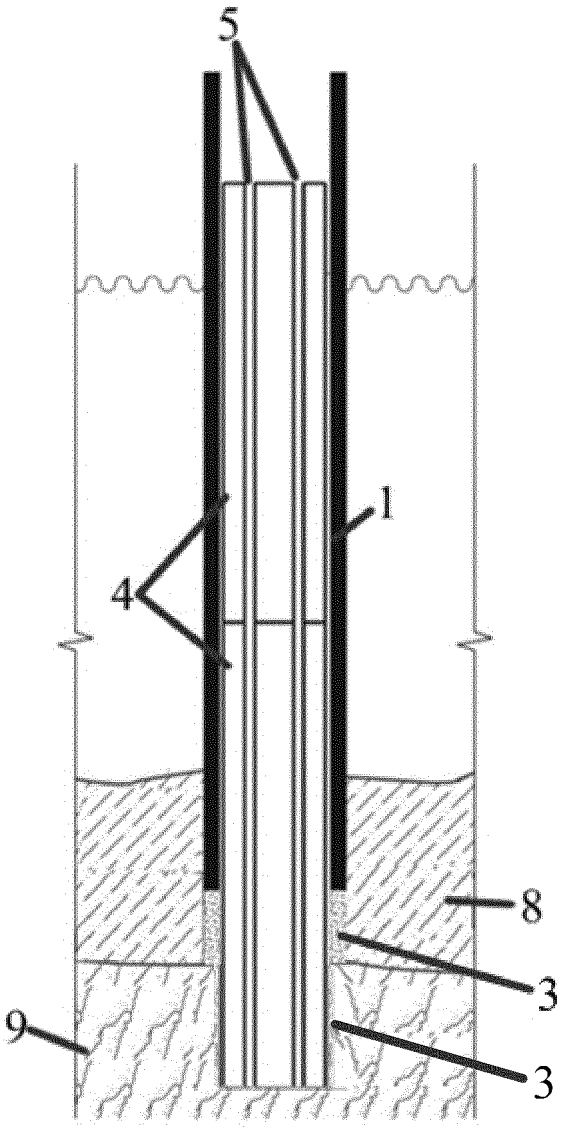

Figure 4

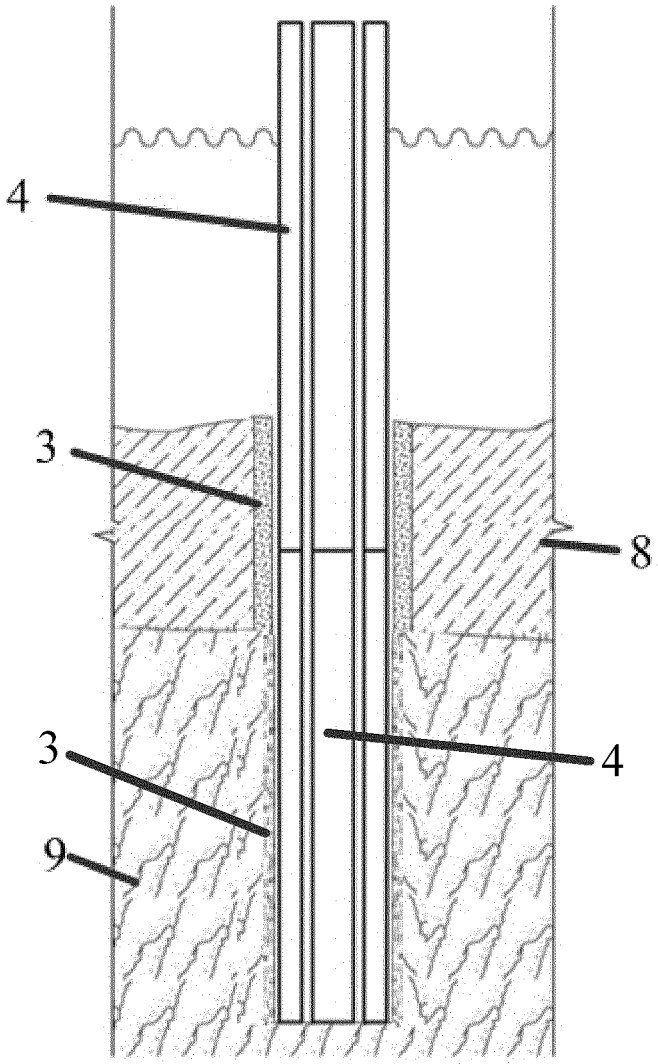

Figure 5

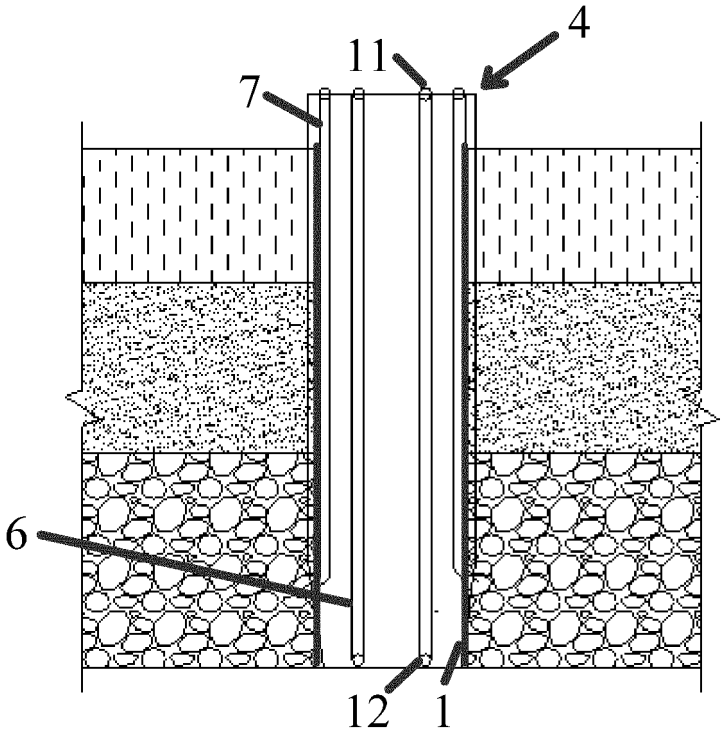

Figure 6

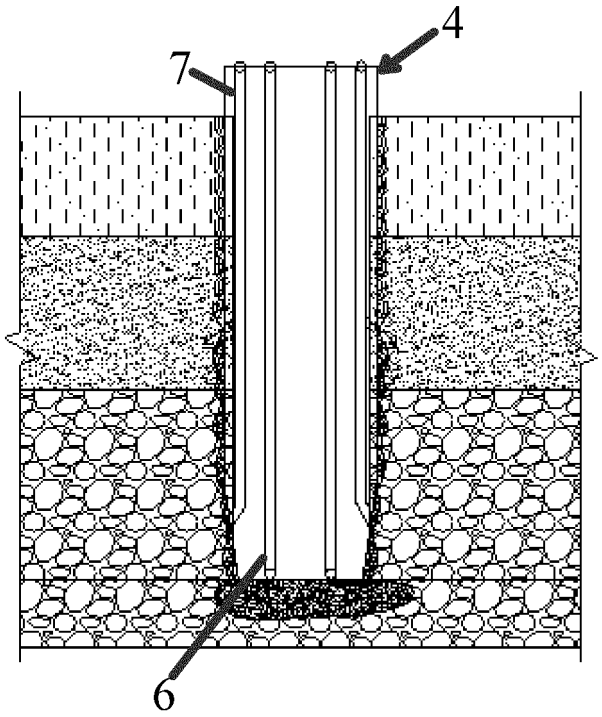

Figure 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/091230

A. CLASSIFICATION OF SUBJECT MATTER

E02D 5/62(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E02D5; E02D7; E02D11

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI, VEN, CNABS, CNTXT: 预制桩, 管桩, 方桩, 预埋, 预留, 灌浆管, 注浆管, 灌注管, 压浆管, 套管, 套筒, 护筒, precast pile, pipe pile, pipepile, tubular pile, grout pipe, injection pipe, sleeve

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 109295972 A (GAO, YONGGUANG ET AL.) 01 February 2019 (2019-02-01) claims 1-3, and description, page 1	1-12
X	CN 102691296 B (GUANGZHOU INSTITUTE OF BUILDING SCIENCE CO., LTD. ET AL.) 11 February 2015 (2015-02-11) description, specific embodiment, and figures 1-3	1-12
X	CN 105442594 A (RISESUN CONSTRUCTION ENGINEERING CO., LTD.) 30 March 2016 (2016-03-30) description, specific embodiments, and figures 1-5	1-12
X	CN 107794925 A (ZHEJIANG UNIVERSITY CITY COLLEGE) 13 March 2018 (2018-03-13) description, specific embodiment, and figures 1-4	11, 12
A	CN 102002945 A (CHINA JINGYE ENGINEERING CO., LTD ET AL.) 06 April 2011 (2011-04-06) entire document	1-12
A	JP 2000129669 A (ASAHI CHEMICAL IND) 09 May 2000 (2000-05-09) entire document	1-12

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 August 2019	**21 August 2019**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China**	Authorized officer
Facsimile No. **(86-10)62019451**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2019/091230

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 109295972 A	01 February 2019	None	
CN 102691296 B	11 February 2015	CN 102691296 A	26 September 2012
CN 105442594 A	30 March 2016	None	
CN 107794925 A	13 March 2018	None	
CN 102002945 A	06 April 2011	CN 102002945 B	25 December 2013
JP 2000129669 A	09 May 2000	None	

Form PCT/ISA/210 (patent family annex) (January 2015)