

METHOD OF INSTALLATION OF SCREWED PILE, METHOD OF
PRODUCTION OF GROUP OF PILES, AND GROUP OF PILES

5 FIELD

[0001]

The present invention relates to a method of installation of a screwed pile, method of production of a group of piles, and a group of piles.

BACKGROUND

10 **[0002]**

In the past, for driving a screwed pile provided with a helical blade etc. into the ground, for example, installation management methods such as in PTLs 1 to 3 etc. have been proposed.

[0003]

15 PTL 1 discloses a method of measuring a height of soil in a pipe in an open end steel pipe with an open tip which provides a light wave distance meter attached to a detachable clamp inside a steel pipe pile and measures by a noncontact method the height of the soil entering inside the pipe when driving the steel pipe pile into the ground.

[0004]

20 PTL 2 discloses a method of installation of a helical steel pipe pile having an opening at the pile tip and having a spiral shaped blade attached to it comprising installing into the opening part a predetermined amount of sand or other granular material in a hard packed state to keep soil of the soft and weak soil layer from entering into the pile during installation until the pile tip reaches the bearing layer.

[0005]

25 PTL 3 discloses a helical type steel pipe pile formed by a top side steel pipe with a large diameter steel pipe pile body and a bottom side steel pipe with a small diameter one and a method of installation of the same. The art disclosed in PTL 3 is characterized by cutting the top of the bottom side steel pipe into a spiral shape, attaching a first helical blade of at least one turn or less matching the cut form of the spiral shape, and providing a second helical blade at an
30 expanded diameter boundary portion L of the steel pipe pile body or the vicinity of the same.

[CITATION LIST]

[PATENT LITERATURE]

[0006]

[PTL 1] Japanese Unexamined Patent Publication No. 2000-230234

35 [PTL 2] Japanese Unexamined Patent Publication No. 2002-167760

[PTL 3] Japanese Unexamined Patent Publication No. 2002-061180

SUMMARY

[TECHNICAL PROBLEM]

[0007]

Here, when screwing a screwed pile into the ground, due to soil clogging the inside of the screwed pile, even if using a pile driver to make the maximum torque act on the screwed pile, driving the pile in sometimes becomes difficult. In particular, when hard soil is formed at a layer shallower than the bearing layer, such clogging of soil easily occurs. Normally, screwed piles are used as a group of piles comprised of several screwed piles, but for example, as shown in FIG. 14, when hard soil is formed at a shallow layer at part of the positions of driving in the screwed piles, it becomes difficult to construct a group of piles as a whole fixed in place at the same bearing layer.

[0008]

On this point, PTL 1 proposes the art of continuously measuring the height of the soil in the pipe in real time during the work of driving in the piles. However, when screwing in the screwed piles, there is a possibility of the direction of the axes of rotation changing along with the increase in misalignment at the screwed piles etc. In this case, in the method described in PTL 1, the axis of the light wave beam changes along with time and the data on the height of the soil in the pipe tends to be liable to become greatly off. Further, along with the screwed pile being screwed in over a long period of time, there is a possibility of dust and soil being scattered inside the pile. In this case as well, in the method described in PTL 1, dirt on the light wave distance meter or damage etc. is liable to cause a drop in the measurement accuracy. Due to this, in the method described in PTL 1, quantitative monitoring over a long period of time is difficult and such clogging of soil is difficult to prevent. Further, in the arts disclosed in PTLs 2 and 3 as well, clogging of soil is difficult to prevent.

[0009]

Therefore, the present invention was made considering the above-mentioned problem and has as its object to provide a method of installation of a screwed pile able to prevent soil from clogging the screwed pile when screwing the screwed pile into the ground and to provide a screwed pile.

[SOLUTION TO PROBLEM]

[0010]

The method of installation of the screwed pile according to a first aspect of the invention is a method of installation driving a screwed pile provided with a blade into the ground characterized by comprising a measurement step of measuring a vertical load in a screwed pile while screwing the screwed pile into the ground and a judgment step of judging whether to unclog soil deposited inside the screwed pile based on the results of measurement obtained by

the measurement step.

[0011]

The method of installation of the screwed pile according to a second aspect of the invention comprises the first aspect of the invention characterized by the measurement step including measuring at least one of a rotational torque of the screwed pile and amount of penetration.

[0012]

The method of installation of the screwed pile according to a third aspect of the invention comprises the first aspect of the invention or the second aspect of the invention characterized in that the judgment step includes comparing the past results of measurement at the time of screwing in screwed piles installed in the past and the results of measurement obtained by the measurement step and judging whether to unclog the soil.

[0013]

The method of installation of the screwed pile according to a fourth aspect of the invention comprises any one of the first to third aspects of the invention characterized by further comprising a step of making the screwed pile reverse and rotate in an extraction direction while screwing in the screwed pile and a step of measuring a vertical load at the screwed pile while rotating in the extraction direction and by judging whether the clogging of soil deposited in the screwed pile has been eliminated based on the results of measurement of the vertical load during rotation in the extraction direction.

[0014]

The method of installation of the screwed pile according to a fifth aspect of the invention comprises the fourth aspect of the invention characterized in that the step of making the screwed pile rotate in reverse is performed when judging in the judgment step to unclog the soil.

[0015]

The method of installation of the screwed pile according to a sixth aspect of the invention comprises any one of the first to third aspects of the invention characterized by further comprising an unclogging step of using an excavation device to remove at least part of the soil and unclog the soil when judging in the judgment step to unclog the soil.

[0016]

The method of installation of the screwed pile according to a seventh aspect of the invention comprises the sixth aspect of the invention characterized by further comprising, after screwing the screwed pile down to the bearing layer, a movement step of making the soil removed using the excavation device move to the inside of the screwed pile.

[0017]

The method of installation of the screwed pile according to an eighth aspect of the

invention comprises any one of the fifth to seventh aspects of the invention characterized in that the measurement step includes measuring an amount of deposition of soil deposited inside the screwed pile.

[0018]

5 The method of installation of the screwed pile according to a ninth aspect of the invention comprises the eighth aspect of the invention characterized by further comprising, after the unclogging step, a confirmation step of measuring the amount of deposition to confirm whether the soil has been unclogged.

[0019]

10 A method of production of a group of piles in a 10th aspect of the invention is characterized by using the method of installation of a screwed pile in any one of the first aspect of the invention to the ninth aspect of the invention to produce a group of piles including a plurality of screwed piles driven down to a bearing layer of the ground.

[0020]

15 A group of piles according to an 11th aspect of the invention is characterized by including a plurality of screwed piles produced by the method of production of a group of piles in the 10th aspect of the invention and driven down to a bearing layer of the ground.

[0021]

20 A screwed pile according to a 12th aspect of the invention is characterized by soil clogging the inside of the screwed pile in a state with the pile driven down to a bearing layer of the ground in the 11th aspect of the invention.

[ADVANTAGEOUS EFFECTS OF INVENTION]

[0022]

25 According to the first aspect of the invention to the ninth aspect of the invention, the measurement step measures a vertical load of a screwed pile while screwing the screwed pile into the ground. The judgment step judges whether to unclog soil deposited in the screwed pile based on the result of measurement obtained at the measurement step. That is, a worker can judge whether to unclog soil deposited in the screwed pile while screwing it in based on the measured vertical load. Due to this, when screwing the screwed pile into the ground, it becomes
30 possible to prevent soil from clogging the inside of the screwed pile.

[0023]

 In particular, according to the second aspect of the invention, the measurement step includes measuring at least one of a rotational torque and amount of penetration of the screwed pile. For this reason, it is possible to perform the judgment step based on the screwed in state of
35 the screwed pile and possible to improve the accuracy of judgment of the judgment step.

[0024]

In particular, according to the third aspect of the invention, the judgment step compares the past results of measurement and the results of measurement in the measurement step and judges if the soil has been unclogged. For this reason, it is possible to make the optimum judgment based on the features of the ground and past installation etc. and becomes possible to further improve the accuracy of judgment.

[0025]

In particular, according to the fourth aspect of the invention, a step is included of making the screwed pile rotate in reverse in the extraction direction in the middle of screwing in the screwed pile and judging if the soil deposited in the screwed pile has been unclogged based on the vertical load measured at that time. Due to this, it is possible to suitably judge unclogging of soil and possible to suitably judge a timing of returning the rotation direction to the insert direction.

[0026]

In particular, according to the fifth aspect of the invention, the unclogging step controls the screwed pile to reverse and unclog the soil when judging to unclog the soil at the judgment step. For this reason, it is possible to leave as data the timing of reversal of the screwed pile or the reversal time period with respect to the vertical load. Due to this, it becomes possible to store details of the installation conditions as data which it utilizes in the future installation.

[0027]

In particular, according to the sixth aspect of the invention, when judging to unclog the soil in the judgment step, the unclogging step uses an excavation device to remove the soil to unclog the soil. For this reason, it is possible to more reliably unclog the soil and possible to obtain a grasp of the amount of soil removed from inside the screwed pile.

[0028]

In particular, according to the seventh aspect of the invention, after screwing the screwed pile down to the bearing layer, the movement step makes the removed soil move to the inside of the screwed pile. For this reason, it is possible to avoid soil being dumped outside of the installation site. Due to this, it becomes possible to cut the man-hours and costs required for dumping the soil outside of the installation site.

[0029]

In particular, according to the eighth aspect of the invention, the measurement step measures the amount of deposition of the soil deposited inside the screwed pile. For this reason, for example, even if using a light wave distance meter falling in accuracy along with screw-in of the screwed pile etc., it is possible to utilize it as an aid in the judgment step. Due to this, it becomes possible to further improve the accuracy of judgment of clogging of soil deposited inside the screwed pile.

[0030]

In particular, according to the ninth aspect of the invention, after the unclogging step, the confirmation step measures the amount of deposition and confirms whether the soil has been unclogged. Due to this, it is possible to more accurately judge if the soil has been unclogged by the unclogging step.

[0031]

According to the 10th aspect of the invention, by driving a plurality of screwed piles down to the bearing layer of the ground by the method of installation of the screwed pile in any of the first aspect of the invention to the ninth aspect of the invention, it becomes possible to produce a group of piles comprised of a plurality of screwed piles driven down to the bearing layer of the ground.

[0032]

According to the 11th aspect of the invention and the 12th aspect of the invention, the group of piles is comprised of a plurality of screwed piles driven down to the bearing layer of the ground by the method of production of a group of piles in the 10th aspect of the invention. For this reason, it becomes possible to prevent clogging of soil during the screw-in and realize a group of piles comprised of a plurality of screwed piles reliably driven down to the bearing layer of the ground.

[0033]

In particular, according to the 12th aspect of the invention, the screwed pile is clogged with soil at the inside in the state driven down to the bearing layer of the ground. In this case, a bearing capacity is obtained by the clogged soil, so the stability of the screwed pile is improved.

BRIEF DESCRIPTION OF DRAWINGS

[0034]

FIG. 1A is a cross-sectional view showing one example of a method of installation of a screwed pile in the present embodiment, FIG. 1B is a cross-sectional view showing a state of driving in a screwed pile down to a bearing layer in the present embodiment.

FIGS. 2A and 2B are cross-sectional views showing one example of screwing a screwed pile into the hard soil in the method of installation of the screwed pile in the present embodiment, while FIG. 2C is a cross-sectional view showing the state of driving a screwed pile down to the bearing layer through the hard soil in the present embodiment.

FIG. 3 is a block diagram showing one example of an installation management system of a screwed pile in the present embodiment.

FIG. 4 is a cross-sectional view showing a state of a screwed pile being driven into the ground in an offset state.

FIG. 5 is a perspective view showing one example of an auger machine and various

measuring devices used in the method of installation of the screwed pile in the present embodiment.

FIG. 6 is a top view showing one example of a casing driver used in the method of installation of the screwed pile in the present embodiment.

FIG. 7A is a cross-sectional view showing one example of the casing driver and various measuring devices used in the installation management system of the screwed pile in the present embodiment while FIG. 7B is a plan view along the line 7B-7B in FIG. 7A.

FIG. 8A is a flow chart showing one example of the method of installation of the screwed pile in the present embodiment, while FIG. 8B is a flow chart showing one example of an unclogging step.

FIG. 9A is a cross-sectional view showing one example of an excavation device used in an unclogging step and movement step, while FIG. 9B is a cross-sectional view showing one example of soil deposited in a screwed pile.

FIG. 10 is a flow chart showing one example of a confirmation step.

FIG. 11 is a side view showing one example of a screwed pile while being screwed in.

FIG. 12A is a cross-sectional view showing one example of a light wave distance meter, while FIG. 12B is a cross-sectional view showing one example of a distance meter.

FIG. 13 is a graph showing one example of an installation record.

FIG. 14 is a view schematically showing a case where there is hard soil at positions of part of the screwed piles forming a group of piles.

DESCRIPTION OF EMBODIMENTS

[0035]

Below, embodiments of the method of installation of the screwed pile and the screwed pile applying the present invention will be explained in detail while referring to the drawings.

[0036]

Method of Installation of Screwed pile and Screwed pile 17

The method of installation of the screwed pile in the present embodiment, as shown in FIG. 1A, is performed for driving a screwed pile 17 into the ground 91. In the method of installation of the screwed pile, for example, the casing driver 21 etc. is used to grip the screwed pile 17, the screwed pile 17 is screwed into the ground 91 in the pile axial direction Z, and the screwed pile 17 is driven down to the bearing layer 92 (for example, FIG. 1B). In the method of installation of the screwed pile, for example, this is performed using the later explained installation management system 100.

[0037]

In the method of installation of the screwed pile, while screwing the screwed pile 17 into the ground 91, for example, the vertical load measuring device 1 shown in FIG. 3 is used to

measure the vertical load of the screwed pile 17. Further, the inventors discovered that by measuring the vertical load of the screwed pile 17 while screwing it in, it is possible to prevent clogging of soil in the screwed pile 17.

[0038]

For example, as shown in FIG. 2A, along with screwing the screwed pile 17 into the ground 91, soil 91a is deposited inside the screwed pile 17 (broken line arrow in FIG. 2A), due to the skin friction between the inside surface of the screwed pile 17 and the soil 91a and the weight of the soil 91a, gradually the inside of the screwed pile 17 becomes clogged with soil (phenomenon where soil 91a inside the screwed pile 17 does not flow even if screwing in the screwed pile 17). In particular, if hard soil 93 etc. is formed at a layer shallower than the bearing layer 92, by the screwed pile 17 being screwed into the hard soil 93, the soil 91a deposited inside the screwed pile 17 becomes larger in friction acting with the inside of the screwed pile 17 and soil 91a easily clogs the inside of the screwed pile 17. In the above such case, as the soil 91a deposits inside the screwed pile 17, the vertical load tends to be measured increasingly larger when screwing in the pile in the insert direction or sometimes a large sporadic value is exhibited. For this reason, by measuring the vertical load, it becomes possible to estimate if clogging of soil 91a has occurred inside the screwed pile 17. However, if a large vertical load is measured, sometimes this is because soft and weak ground changes to hard soil or the pile tip contacts an obstacle in the ground such as a boulder.

[0039]

At this time, for example, as shown by the solid line arrows shown in FIG. 2B, if the screwed pile 17 is made to reverse, if no clogging of soil has occurred, the vertical load immediately falls. When the degree of clogging is moderate, it is possible to unclog the soil 91a deposited inside the screwed pile 17 (broken line arrow in FIG. 2B) and as a result the vertical load falls. On the other hand, when reversing the screwed pile and moving it in the extraction direction, sometimes the vertical load does not fall but a large value is maintained. In this case as well, by measuring the vertical load, it is possible to estimate whether soil 91a in the screwed pile 17 has been unclogged. If the vertical load does not drop, it can be judged that the clogging has not been eliminated, so the screwed pile is again reversed and operated to move in the extraction direction. A similar operation is repeated until the clogging is eliminated.

[0040]

Below, from the results of measurement shown in FIG. 13, one example of what kind of judgment to perform so as to drive a screwed pile through the hard soil without causing clogging of soil during installation will be explained in order in the following [1] to [7].

[0041]

[1] It is predicted that there are layers of hard soil at a depth of 11 to 19 m and a depth of

26 to 33 m from the relationship between the N value and depth of FIG. 13 found by a survey at a position near the pile driving site in advance.

[0042]

[2] From the relationship of the vertical load and depth of FIG. 13 measured when driving in the pile, the vertical load rapidly rises near the depth of 11 m.

[0043]

[3] Here, the vertical load fell when reversing the pile once, so installation was continued by the normal driving method, but the vertical load tended to gradually increase near a depth of 12 m, so the pile is reversed to start the operation of moving the screwed pile in the extraction direction.

[0044]

[4] The pile is made to rotate in the extraction direction. When the vertical load falls, it is again driven in by forward rotation, but the vertical load continues to tend to gradually increase, so the pile is operated to reverse every 10 cm or so driven in.

[0045]

[5] This operation is continued until a depth of 12 to 19 m. At that time, the vertical load stabilizes at a low level at a depth of 19 m, so it is judged that the hard soil has been driven through without causing clogging of soil. Installation is continued by the usual driving method from the depth of 19 m.

[0046]

[6] The vertical load again rapidly rises near a depth of 26 m where hard soil is predicted to start, so the hard soil is passed through by a similar operation as the above-mentioned depth 11 to 19 m until a depth of 26 to 33 m.

[0047]

[7] The installation is performed by a normal driving method from a depth of 33 m. The pile stopped being driven in at a depth of 37 m.

[0048]

In the above way, for example, as shown in FIG. 2C, it becomes possible to drive the screwed pile 17 down to the bearing layer 92 without causing clogging of the soil 91a inside the screwed pile 17 even for ground 91 including hard soil 93.

[0049]

The screwed pile 17 in the present embodiment is comprised of a screwed pile body and a spiral shaped helical blade 16 provided at its tip. The screwed pile body is, for example, comprised of a plurality of steel pipes welded together in the pile axial direction Z. The screwed pile 17 is driven into the ground 91. For example, the pile tip is driven into the bearing layer 92. Note that, the shape of the blade of the screwed pile 17 is not limited to a spiral. For example,

instead of a helical blade 16, it is also possible to provide a pair of semicircular shaped blades at the screwed pile body.

[0050]

The pile diameter of the screwed pile 17 is, for example, $\phi 100$ mm to 1600 mm or so. The pile plate thickness is, for example, 4.2 mm to 25 mm or so. The diameter of the helical blade 16 is, for example, 1.5 times to 2.5 times or so the pile diameter. The bearing layer 92 into which the pile tip of the screwed pile 17 is driven, for example, is made of sand, gravel soil, or cohesive soil or a layer with a soil quality of sandy soil or gravelly soil and has an N value of 15 or more.

[0051]

In the method of installation of the screwed pile, for example, the installation management system 100 shown in FIG. 3 is used. The installation management system 100 is provided with an installation management device 6. FIG. 3 is a schematic view of the arrangement of various measuring devices 1 to 5 for measuring information showing the state of installation of the screwed pile 17 (pile information) and an installation management device 6.

[0052]

The installation management system 100 is provided with a vertical load measuring device 1 measuring a vertical load of the screwed pile 17. For example, it is provided with at least one of a rotational angle measuring device 2, penetration measuring device 3, rotational torque measuring device 4, and deviation measuring device 5. The installation management system 100 may be provided with a data converter 7 able to transfer data with the above-mentioned various measuring devices 1 to 5 and an interface box 8 connecting the data converter 7 and the installation management device 6. Note that, the installation management system 100 may, for example, be provided with a data input part 9 able to input data of the N value investigated in advance by a soil survey. Also, for example, the data of the N value may be stored in advance in an installation management device 6. The installation management device 6 acquires data from the various measuring devices 1 to 5 etc., processes it as required, and displays the results on the monitor screen 6b or can print them out by a printer 6c connected to the system.

[0053]

In the method of installation of the screwed pile, for example, as shown in FIG. 4, the deviation measuring device 5 is used to measure the amount of deviation of the screwed pile 17 while screwing the screwed pile 17 into the ground 91. The amount of deviation shows at least one of the amount of movement in the plane from the initial set position of the screwed pile 17 (misalignment of position) and amount of tilt (amount of change of inclination angle) accompanying screw in of the screwed pile 17. Note that, for example, the bearing plate 41

sandwiched between the ground 91 and the casing driver 21 gripping the screwed pile 17 can be used to obtain the amount of deviation of the screwed pile 17. In this case, it is possible to measure the amount of positional offset of the bearing plate 41 accompanying screw-in of the screwed pile 17 as the amount of deviation of the screwed pile 17.

5 **[0054]**

Here, the amount of deviation of the screwed pile 17 during screw in shows the tendency relating to the degree of offset of the screwed pile 17 in the pile axis perpendicular direction X (misalignment). The offset of the screwed pile 17, for example, as shown in FIG. 4, occurs when screwing the screwed pile 17 into the ground 91. The misalignment of the screwed pile 17 tends to become larger when the helical blade 16 of the screwed pile 17 contacts the hard soil 93. Accordingly, the information obtained from the amount of deviation becomes one of the indicators showing that the screwed pile 17 has reached the hard soil 93.

[0055]

Auger Machine 15

15 In the installation management system 100 of the screwed pile, as the screw-in device of the screwed pile 17, for example, a pile driver leader 10 and auger machine 15 are used. FIG. 5 is a perspective view showing one example of the pile driver leader 10 and auger machine 15.

[0056]

The pile driver leader 10, for example, as shown in FIG. 5, is provided with a pile driver body 13 on a turn table 12 supported by an endless track 11. It is configured with an inclined support arm 14 extending upward from the two side parts of one end of the pile driver body 13. The auger machine 15 is supported at the top end of this inclined support arm 14. The auger machine 15 grips the pile head of the screwed pile 17. The installation management device 6 is, for example, connected to the data converter 7 attached to the driver's compartment 19 and obtains various types of data.

25 **[0057]**

The vertical load measuring device 1 measures the vertical load (pressing force) given to the pile head of the screwed pile 17. As the vertical load measuring device 1, for example, the load cell 1a is used. The load cell 1a is attached between the top end of the pile driver leader 10 and the end part of the wire rope 3a suspending the auger machine 15 and measures the tensile force of the wire rope 3a. For this reason, the vertical load acting on the screwed pile 17 becomes the weight of the auger machine 15 minus the measured value of the load cell 1a. Note that, if the vertical load is insufficient with just the weight of the auger machine 15, sometimes another wire rope is provided pulling in the auger machine 15 using the pile driver body 13 as a reaction body. In this case, a load cell 1a is attached to the other wire rope as well and the measurement data of the two load cells 1a are added to obtain the vertical load.

[0058]

As the vertical load measuring device 1, the above-mentioned load cell 1a is used. In addition, a known press-in force measuring device may be used. For example, in a rack pinion type pile driver where a hydraulic type auger machine 15 can be attached directly to a pile driver leader 10, a pressure sensor may be attached to the auger machine 15 as the vertical load measuring device 1.

[0059]

The rotational angle measuring device 2 measures the rotational angle of the screwed pile 17. As the rotational angle measuring device 2, for example, a rotational angle measurement sensor having a magnetic reaction proximity switch 2a and metal pieces 2b is used. The magnetic reaction proximity switch 2a is provided at a nonrotating frame member 15b of the auger machine 15. A plurality of metal pieces 2b (for example, 2 to 8 locations) are provided at the rotation body 15c at the body part 15a of the auger machine 15.

[0060]

In such a rotational angle measurement sensor, the screwed pile 17 and rotation body 15c rotate. Every time a metal piece 2b approaches the magnetic reaction proximity switch 2a in a noncontact manner, a pulse signal is generated and the rotational angle can be measured. For example, when providing metal pieces 2b evenly at eight locations in the pile circumferential direction W, a pulse signal is generated every rotational angle of 45 degrees. Further, for example, when providing metal pieces 2b evenly at two locations in the pile circumferential direction W, a pulse signal is generated every rotational angle of 180 degrees.

[0061]

As the rotational angle measuring device 2, the system of using the above-mentioned rotational angle measurement sensor is the simplest and least prone to breakdowns, but another contact switch system or encoder angle sensor or other system using a known configuration may also be employed.

[0062]

The penetration measuring device 3 measures the amount of penetration of the screwed pile 17. As the penetration measuring device 3, for example, a penetration measurement sensor having a wire rope 3a and encoder 3b is used. The wire rope 3a is connected at its front end to the auger machine 15 and is provided so as to be turned around at the front end of the pile driver leader 10 and guided to the pile driver body 13 around which it is wound. The encoder 3b is provided on the pile driver body 13 and measures the amount of movement of the wire rope 3a as the amount of penetration of the screwed pile 17.

[0063]

As the penetration measuring device 3, a known measurement sensor etc. may be used in

addition to the above-mentioned penetration measurement sensor.

[0064]

The rotational torque measuring device 4 measures the rotational torque when screwing in the screwed pile 17. As the rotational torque measuring device 4, for example, an auger
5 ammeter 4a is used. In this case, it is possible to measure this by a drive current of an auger - a known measurement means used since the past.

[0065]

The deviation measuring device 5 is used in the state fixed to the ground 91. The deviation measuring device 5, for example, measures the distance to the screwed pile 17. The
10 deviation measuring device 5, for example, measures the distance to the screwed pile 17 while screwing it in using the distance from the screwed pile 17 before screwing it into the ground 91 (initial state) as the initial value and measures the difference in the distances (amounts of positional offset) as the amount of deviation.

[0066]

15 As the deviation measuring device 5, for example, a laser distance meter or other such known distance measuring device is used. Note that, it is also possible to use the installation management device 6 to measure the amount of deviation based on the distance until the screwed pile 17 measured by the deviation measuring device 5.

[0067]

20 Note that, as the deviation measuring device 5, for example, an inclinometer may be used. In this case, the deviation measuring device 5 is attached to the auger machine 15, screwed pile 17, etc. In this case, the inclination angle while screwing in the pile is measured using the inclination angle at the initial state as the initial value and the difference at the inclination angles (amount of change) is measured as the amount of deviation.

25 **[0068]**

Further, as the deviation measuring device 5, for example, either of a distance measuring device and inclinometer may be used. In this case, a value combining the amount of positional offset and amount of change is measured as the amount of deviation.

[0069]

30 Casing Driver 21

In the installation management system 100 of the screwed pile, for example, as shown in FIG. 6 and FIG. 7, as the screw-in device of the screwed pile 17, a casing driver 21 may be used. FIG. 6 is a top view showing one example of the casing driver 21. FIG. 7 is a schematic view showing one example of the casing driver 21.

35 **[0070]**

In this case as well, the installation management system 100 is similar in main

configuration to that shown in the above-mentioned FIG. 3. Below, the configurations different from the case of providing the auger machine 15 will be explained. Similar configurations will be suitably omitted in the explanations.

[0071]

5 The casing driver 21, for example, as shown in FIG. 6, is supported by a crawler crane 21a through a reaction bar 21b. The screwed pile 17 is inserted inside the casing driver 21 in the state suspended by the crawler crane 21a.

[0072]

10 The casing driver 21, for example, as shown in FIG. 7A, is provided on the bearing plate 41 and grips the screwed pile 17. As the casing driver 21, for example, a known casing driver having pedestals 26, thrust jack 24, nonrotating frame member 27, hydraulic motor 23, swivel ring 22, and gripping part 25 is used.

[0073]

15 The pedestals 26, for example, may be directly provided on the ground 91 in addition to being provided on the bearing plate 41. The pressing use trust jack 24 is set on the pedestals 26. For example, four are used. The nonrotating frame member 27 is attached to the thrust jack 24. The hydraulic motor 23 is supported at the nonrotating frame member 27 and causes a rotational torque to act on the swivel ring 22. The swivel ring 22 rotates by the hydraulic motor 23 through a gear mechanism 28 and a bearing mechanism 29. The gripping part 25 is connected to the top
20 part of the swivel ring 22 to rotate integrally with it and uses a handle 30 to grip the screwed pile 17.

[0074]

 For example, when the bearing plate 41 is provided, the bearing plate 41 is sandwiched between the casing driver 21 and the ground 91. The bearing plate 41 tends to become offset in
25 position at which it is set together with the casing driver 21 and screwed pile 17 along with the increase in misalignment in the screwed pile 17 while screwing in the pile.

[0075]

 As the vertical load measuring device 1, for example, a known pressure sensor measuring the hydraulic pressure of the thrust jack 24 can be used.

30 **[0076]**

 As the rotational angle measuring device 2, the above-mentioned rotational angle measurement sensor can be used. In this case, the magnetic reaction proximity switch 2a is provided on the nonrotating frame member 27. The metal pieces 2b are provided on the swivel ring 22. Due to this, in the same way as the above-mentioned rotational angle measurement
35 sensor, a pulse signal is generated in accordance with rotation of the screwed pile 17 and the rotational angle can be measured.

[0077]

As the penetration measuring device 3, for example, a stroke sensor 3c measuring the stroke of a thrust jack 24 can be used. The stroke sensor 3c is provided between a cylinder 24a of a thrust jack 24 and a pedestal 26. As the stroke sensor 3c, for example, a linear type
5 displacement meter, a potentiometer type using a cord, or other known measurement system can be used.

[0078]

As the rotational torque measuring device 4, for example, a known pressure sensor (hydraulic sensor) measuring the hydraulic pressure of the hydraulic motor 23 driving rotation of
10 the swivel ring 22 can be used.

[0079]

The deviation measuring device 5 is provided on the ground 91 separated from the bearing plate 41. In this case, the deviation measuring device 5, for example, measures the distance until the bearing plate 41 while screwing in the screwed pile 17 using the distance until
15 the bearing plate 41 in the initial state as the initial value and measures the difference in the distances (amount of positional offset) as the amount of deviation of the screwed pile 17.

[0080]

While screwing in the screwed pile 17, the range of deviation of the screwed pile 17 includes deviation in inclination in addition to deviation of the plane parallel to the ground 91.
20 For this reason, it is preferable to measure at least one of the deviation of the plane and deviation of the inclination.

[0081]

Here, the range of deviation of the bearing plate 41 is only the deviation of the plane parallel to the ground 91 (amount of movement in horizontal plane). For this reason, if using the
25 deviation measuring device 5 to measure the amount of positional offset of the bearing plate 41 as the amount of deviation of the screwed pile 17, the range of deviation becomes narrower compared with when directly measuring the amount of deviation of the screwed pile 17. Further, when directly measuring the amount of deviation of the screwed pile 17, it is necessary to measure this during rotation of the screwed pile 17. Sometimes the variation in measurement
30 accompanying rotation becomes larger. If based on these, by measuring the amount of positional offset of the bearing plate 41 as the amount of deviation of the screwed pile 17, it is possible to suppress variation of the measurement value.

[0082]

The deviation measuring device 5, for example, may be provided on the bearing plate 41.
35 In this case, by providing a reference measurement part on the ground 91 separate from the bearing plate 41 (for example, the position of the deviation measuring device 5 of FIG. 7A) and

measuring the distance to the reference measurement part, it is possible to measure the amount of deviation of the screwed pile 17 in the same way as above.

[0083]

Example of Method of Installation of Screwed pile

5 Next, one example of the method of installation of the screwed pile in the present embodiment will be explained with reference to FIG. 8. FIG. 8 is a flow chart showing one example of the method of installation of the screwed pile in the present embodiment.

[0084]

10 The method of installation of the screwed pile in the present embodiment is provided with a screw-in step S100, measurement step S110, and judgment step S120. For example, while performing the screw-in step S100, the measurement step S110 and judgment step S120 are suitably repeated.

[0085]

Screw-in Step S100

15 The screw-in step S100 uses the auger machine 15 or the casing driver 21 to grip the screwed pile 17 and makes the tip at which the helical blade 16 is provided strike the ground 91. After that, the screwed pile 17 is screwed into the ground 91.

[0086]

Measurement Step S110

20 The measurement step S110 measures the vertical load at the screwed pile 17 while screwing the screwed pile 17 into the ground 91. At the measurement step S110, for example, the vertical load is periodically measured. The period for measuring the vertical load is, for example, a predetermined value of 1 second to 60 seconds and can be freely set in accordance with the installation conditions etc. If making the period of measurement of the vertical load shorter, the
25 state of the screwed pile 17 can be monitored with a high accuracy. On the other hand, if making the period for measuring the vertical load longer, it is possible to slash the amount of data stored.

[0087]

 In particular, by making the period for measuring the vertical load 10 seconds or less, it is possible to easily obtain a grasp of the soil 91a deposited in the screwed pile 17. If estimating the
30 amount of deposition of the soil 91a in the screwed pile 17, in addition to estimating the amount from the gentle trend of increase of the vertical load, it is possible to estimate it by sporadic fluctuation of the vertical load. In this case, by setting the period to a measurement period of over 10 seconds, sporadic fluctuation of the vertical load is not measured and the possibility of missing closure by soil 91a rises. For this reason, the period of measuring the vertical load is
35 preferably 10 seconds or less.

[0088]

Judgment Step S120

Next, the judgment step S120 judges whether to unclog soil 91a deposited inside the screwed pile 17 based on the results of measurement obtained at the measurement step S110. At the judgment step S120, for example, reference pile information relating to the preset conditions of screwing in the screwed pile 17 is referred to as judgment reference to judge whether to unclog the soil 91a deposited in the screwed pile 17. The reference pile information, for example, shows the absolute value of the vertical load, the difference from the immediately preceding value or threshold value or allowable range or other management value based on the cumulative value, average value, or standard error for a certain period. For the reference pile information, the threshold value of the vertical load can be freely set in accordance with the pile diameter of the screwed pile 17, the diameter of the helical blade 16, the N value, the depth of the ground 91, etc.

[0089]

The reference pile information, for example, may include the past results of measurement at the time of screwing in the screwed pile 17 installed in the past. In this case, the judgment step S120 compares the reference pile information including the past results of measurement and the results of measurement of the vertical load at the measurement step S110 and judges whether to unclog the soil 91a. For this reason, it is possible to make the optimal judgment based on the features of the ground 91, results of installation, etc.

[0090]

Unclogging Step S121

The method of installation of the screwed pile, for example, as shown in FIG. 8B, may be provided with an unclogging step S121. The unclogging step S121 is performed in the case of judging to unclog soil 91a at the judgment step S120.

[0091]

In the unclogging step S121, for example, as shown in FIG. 2B, the screwed pile 17 is controlled to reverse and thereby generate a force opposite to the screw-in direction to the soil 91a deposited in the screwed pile 17 and unclog the soil 91a inside the screwed pile 17. In this case, by just controlling the rotational conditions of the screwed pile 17, it is possible to unclog the soil 91a deposited inside the screwed pile 17, so the time wasted for unclogging the soil 91a can be shortened.

[0092]

In addition to the above, at the unclogging step S121, for example, as shown in FIG. 9, the excavation device 51 may be used to remove at least part of the soil 91a deposited in the screwed pile 17 and unclog the soil 91a inside the screwed pile 17. As the excavation device 51, for example, a hammer clamp suspended from a crane 50 etc. is used. In this case, for example,

as shown in FIG. 9B, since the excavation device 51 is used to directly remove soil 91a, it is possible to reliably unclog the soil 91a and possible to obtain a grasp of the amount of the soil 91a removed from the screwed pile 17.

[0093]

Note that, for example, when again performing the measurement step S110 after the unclogging step S121, by comparing the result of measurement of the vertical load measured after the unclogging step S121 and the result of measurement of the vertical load measured before the unclogging step S121, it is possible to confirm whether the soil 91a has been unclogged. A step of confirming whether the soil 91a has been unclogged may be provided as a confirmation step S123 in the method of installation of the screwed pile. Further, the results of measurement may be compared using the results of processing by the installation management device 6.

[0094]

Due to this, the method of installation of the screwed pile in the present embodiment ends. Note that, as shown in FIG. 8A, by again performing the measurement step S110 after performing the judgment step S120 and repeatedly performing these steps as required, it is possible to drive in the screwed pile 17 according to any depth of the ground 91. In particular, by again performing the measurement step S110 after judging not to unclog the soil 91a at the judgment step S120, it is possible to continue and proceed with the screwing in the screwed pile 17.

[0095]

Note that, in the method of installation of the screwed pile, for example, a movement step S122 may be further provided. The movement step S122 uses the excavation device 51 to make the removed soil 91a move into the screwed pile 17 after screwing in the screwed pile 17 down to the bearing layer 92. Specifically, in the unclogging step S121, the removed soil 91a, for example, as shown in FIG. 9A, is provisionally placed on the ground 91 and moved into the screwed pile 17 at the movement step S122. For this reason, it is possible to avoid soil 91a being dumped outside of the installation site.

[0096]

First Modification of Method of Installation of Screwed pile

Next, a first modification of the method of installation of the screwed pile in the present embodiment will be explained. The difference of the above-mentioned method of installation of the screwed pile and the first modification lies in the point of measurement of parameters other than the vertical load of the screwed pile 17 in the measurement step S110. Note that, explanations of configurations similar to the above-mentioned method of installation of the screwed pile will be omitted.

[0097]

In the measurement step S110, for example, in addition to the vertical load, at least one of the rotational angle of the screwed pile 17, the amount of penetration of the screwed pile 17, the rotational torque of the screwed pile 17, and the amount of deviation of the screwed pile 17 may be measured as pile information. At the measurement step S110, the rotational angle of the screwed pile 17, the amount of penetration of the screwed pile 17, and the rotational torque of the screwed pile 17 are respectively, for example, measured using the above-mentioned rotational angle measuring device 2, penetration measuring device 3, and rotational torque measuring device 4.

[0098]

In the measurement step S110, if measuring the amount of deviation of the screwed pile 17, for example, the deviation measuring device 5 is used to measure the amount of deviation from the screwed pile 17. In this case, for example, the amount of positional offset of the bearing plate 41 is measured as the amount of deviation of the screwed pile 17. Further, at the measurement step S110, instead of the deviation measuring device 5, for example, a ruler, gauge, or other measurement instrument may be used to measure the amount of amount of deviation. In this case, for example, a worker uses the measurement instrument to measure the positional offset from the initial value of the bearing plate 41 to measure the amount of deviation of the screwed pile 17. For example, it is also possible to input the value measured by the worker into the installation management device 6 to measure the amount of deviation.

[0099]

A worker may also use a measurement instrument to measure the amount of positional offset so as to smoothly perform the measurement step S110 even in a location where the deviation measuring device 5 cannot be set. Note that, for example, it is possible to use a portable small sized deviation measuring device 5 to have a worker perform the measurement and measure the amount of deviation of the screwed pile 17.

[0100]

The judgment step S120, for example, as shown in FIG. 10, may compare the above-mentioned reference pile information and the amount of deviation or other results of measurement (pile information) and judge normality or abnormality. In this case, the conditions for screwing in the screwed pile 17 are controlled based on the results of judgment. Further, based on the screw-in conditions of the screwed pile 17, it is possible to improve the accuracy of judgment of whether to unclog the soil 91a deposited inside the screwed pile 17.

[0101]

In the judgment step S120, for example, if the amount of deviation etc. exceeds the threshold value included in the reference pile information, the conditions for reduction or

reversal of the rotational torque are set. Note that, the above-mentioned “control of the screw-in conditions of the screwed pile 17” includes not only the case of changing the conditions of screwing in the screwed pile 17 based on the pile information, but also the case of screwing in the pile without changing the conditions and the case of stopping the screwing.

5 **[0102]**

In the judgment step S120, as the method of comparing the reference pile information and the amount of deviation etc., for example, the installation management device 6 is used to compare the reference pile information and the amount of deviation etc. and the result of classification of the amount of deviation etc. into normal or abnormal is displayed on the monitor
10 screen 6b. At this time, it is also possible to display an alert or for example emit a sound so that the worker can reliably recognize the situation. In addition to this, for example, a worker may also finally judge normality or abnormality. If the worker judges the operation is normal from the results of measurement displayed on the monitor screen 6b or the results of comparison, the screw-in conditions of the screwed pile 17 are controlled and the measurement step S110 is
15 performed or the installation ended.

[0103]

In the first modification, for example, a confirmation step S123 may be further provided. The confirmation step S123 confirms the state of the screwed pile 17 when judging the amount of deviation abnormal in the judgment step S120. At this time, for example, the rotation of the
20 screwed pile 17 is stopped and the state of the screwed pile 17 is confirmed.

[0104]

Reference Pile Information

Next, one example of the reference pile information in the first modification will be explained with reference to FIG. 11.

25 **[0105]**

As the reference pile information, for example, as shown in FIG. 11, the allowable range of the amount of penetration S per rotation of the screwed pile 17 with respect to the pitch P of the helical blade 16 may be included. In this case, the rotational angle included in the pile information measured by the measurement step S110 and the amount of penetration are used to
30 calculate the amount of penetration S per rotation. Further, the amount of penetration S per rotation calculated and the allowable range of the amount of penetration S per rotation of the reference pile information are compared and the vertical load N is controlled based on the results of comparison. Note that, the amount of penetration S per rotation may be calculated by the worker in addition to being calculated by the installation management device 6.

35 **[0106]**

For example, if the amount of penetration S per rotation calculated is larger than the

amount of penetration S per rotation set in the reference pile information, it is possible to decrease the vertical load N to make the amount of penetration S per rotation calculated using the next measured rotational angle and amount of penetration approach the amount of penetration S per rotation set in the reference pile information. Due to this, for example, it becomes possible to efficiently perform the installation without unreasonable load acting on the helical blade 16 or without disturbing the soil 91a of the tip at the screwed pile 17.

[0107]

Second Modification of Method of Installation of Screwed pile

Next, a second modification of the method of installation of the screwed pile in the present embodiment will be explained. The difference of the above-mentioned method of installation of the screwed pile and the second modification is the point of directly measuring the amount of deposition of the soil 91a deposited in the screwed pile. Note that, explanations of the configuration similar to above-mentioned method of installation of the screwed pile will be omitted.

[0108]

In the measurement step S110, for example, in addition to the vertical load, measurement of the amount of deposition of the soil 91a may be included. The amount of deposition of the soil 91a is, for example, measured using the distance meter 18 shown in FIG. 12.

[0109]

At the measurement step S110, for example, as shown in FIG. 12A, as the distance meter 18, the light wave distance meter 81 is used. In this case, for example, at the screw-in step S100, the light wave distance meter 81 is attached fastened to the clamp 83 provided detachably above the screwed pile 17. Due to this, by measuring the light wave beam 84 emitted from the light wave distance meter 81, it is possible to measure in a noncontact manner the distance up to the top surface of the soil 91a in the screwed pile 17 and possible to measure the amount of deposition of the soil 91a. For the light wave distance meter 81 used as the distance meter 18, any laser distance meter can be used.

[0110]

By measuring the amount of deposition of the soil 91a at the measurement step S110, it is possible to utilize the amount as an aid of the judgment step S120. In the measurement step S110, for example, it is also possible to perform the judgment at the judgment step S120 based on the change along with time of the amount of deposition of the soil 91a measured. For example, when there is no change compared with the amount of deposition of the soil 91a measured in advance at the measurement step S110, it is possible to estimate that the soil 91a has clogged in the screwed pile 17. In this case, in the judgment step S120, it is also possible to judge to unclog the soil 91a deposited in the screwed pile 17. In this way, it becomes possible to

make a quantitative judgment even in a case where the installation conditions differ by performing the judgment at the judgment step S120 based on the changes along with time of the amount of deposition of the soil 91a measured. Note that, the “amount of deposition of the soil 91a measured in advance” may be the result of measurement directly before and also the result of measurement for example at predetermined time before and may be freely set in accordance with the situation.

[0111]

In particular, by measuring the amount of deposition at the confirmation step S123 after performing the above-mentioned unclogging step S121, it is possible to more reliably judge whether to unclog the soil 91a in the screwed pile 17. Note that, at the confirmation step S123, for example, as shown in FIG. 12B, as the distance meter 18, one with a weight 85 attached to a level measuring rope 86 may also be used. In this case, by placing the weight 85 on the top surface of the soil 91a and measuring the length of extension of the level measuring rope 86, it is possible to measure the amount of deposition of the soil 91a.

[0112]

Installation Record

Next, one example of the installation record utilized in the method of installation of the screwed pile in the present embodiment will be explained with reference to FIG. 13. FIG. 13 is a graph showing one example of an installation record with the N value of the ground 91, the rotational torque of the screwed pile 17, the amount of penetration of the screwed pile 17, and the vertical load of the screwed pile 17 respectively plotted for each depth of the ground 91. In FIG. 13, the regions corresponding to the hard soil 93 are shown by the first region R1 and second region R2 and the position corresponding to the top surface of the bearing layer 92 is shown as the position D1.

[0113]

The vertical load tends to become larger the greater the depth (the deeper). Further, when the screwed pile 17 is screwed in inside the regions R1, R2, the points of rapid rise P1, P2 of the vertical load are detected. Further, when performing the measurement step S110 and measuring the points of rapid rise P1, P2, at the judgment step S120, it is judged to “unclog the soil 91a”. Further, when screwing in the pile inside the regions R1, R2, the rotational torque of the screwed pile 17 tends to greatly increase. For this reason, by measuring the rotational torque in addition to the vertical load, it is possible to utilize this as an auxiliary indicator of judgment in the judgment step S120.

[0114]

As the rapidly rising points P1, P2, for example, it is also possible to judge measurement values as points of rapid rise when the measurement value of the vertical load at the

measurement step S110 at the point of time of judgment is 2 times or more the average value of the vertical load measured at the measurement step S110 before the time of judgment.

[0115]

Note that, for example, in the judgment step S120, the installation management device 6 may also assist judgment. That is, the installation management device 6 may also display warning information on a monitor screen 6b warning a worker of abnormalities (for example an alert) when judging it is necessary to unclog soil 91a or when judging the amount of deviation etc. is abnormal. Due to this, a worker does not have to constantly check the monitor screen 6b and becomes possible to improve the work efficiency. Further, it is possible to keep down variation in the objective judgment criteria for each worker. Due to this, it becomes possible to prevent clogging of soil 91a in the screwed pile 17 without relying on the degree of work skills of the workers.

[0116]

According to the method of installation of the screwed pile in the present embodiment, the measurement step S110 measures the vertical load of the screwed pile 17 while screwing the screwed pile 17 into the ground 91. The judgment step S120 judges whether to unclog the soil 91a deposited inside the screwed pile 17 based on the results of measurement at the measurement step S110. That is, a worker can judge whether to unclog the soil 91a deposited inside the screwed pile 17 while screwing in the pile based on the measured vertical load and can prevent clogging of soil 91a in the screwed pile 17 when screwing the screwed pile 17 into the ground 91.

[0117]

Further, according to the method of installation of the screwed pile in the present embodiment, the measurement step S110 includes measurement of at least one of the rotational torque and amount of penetration of the screwed pile 17. For this reason, it is possible to perform the judgment step S120 based on the screwed in state of the screwed pile 17 and possible to improve the accuracy of judgment in the judgment step S120.

[0118]

Further, according to the method of installation of the screwed pile in the present embodiment, the judgment step S120 compares the past results of measurement and the results of measurement at the measurement step S110 and judges whether to unclog the soil 91a. For this reason, it is possible to make the optimum judgment based on the features of the ground 91 or installation record etc. and possible to further improve the accuracy of judgment.

[0119]

Further, according to the method of installation of the screwed pile in the present embodiment, when the judgment step S120 judges to unclog the soil 91a, the unclogging step

S121 controls the screwed pile 17 to reverse and unclog the soil 91a. For this reason, it is possible to leave as data the timing and reversal time period etc. of reversing the screwed pile 17 with respect to the vertical load. Due to this, it is possible to store details of the installation conditions as data and possible to utilize it for further installation.

[0120]

Further, according to the method of installation of the screwed pile in the present embodiment, when the judgment step S120 judges to unclog the soil 91a, the unclogging step S121 uses the excavation device 51 to remove the soil 91a and unclog the soil 91a. For this reason, it is possible to more reliably unclog the soil 91a and possible to obtain a grasp of the amount of soil 91a removed from inside the screwed pile 17.

[0121]

Further, according to the method of installation of the screwed pile in the present embodiment, in the movement step S122, after screwing in the screwed pile 17 down to the bearing layer 92, the removed soil 91a is moved to the inside of the screwed pile 17. For this reason, it is possible to avoid soil 91a from being dumped outside of the installation site. Due to this, it becomes possible to cut the man-hours and costs required for dumping the soil 91a outside of the installation site.

[0122]

Further, according to the method of installation of the screwed pile in the present embodiment, the measurement step S110 measures the amount of deposition of the soil 91a deposited in the screwed pile 17. For this reason, for example, even when using a light wave distance meter 81 whose precision falls along with the screwing in the screwed pile 17 etc., it is possible to use this as an aid in the judgment step S120. Due to this, it becomes possible to further improve the precision of judgment of clogging of soil 91a deposited inside the screwed pile 17.

[0123]

Further, according to the method of installation of the screwed pile in the present embodiment, the confirmation step S123 measures the amount of deposition after the unclogging step S121 and confirms that the soil 91a has been unclogged. Due to this, it is possible to more accurately judge if the soil 91a has been unclogged by the unclogging step S121.

[0124]

Further, according to the screwed pile 17 in the present embodiment, the screwed pile penetrates to the bearing layer 92 of the ground 91 due to the above-mentioned method of installation. For this reason, it becomes possible to realize a screwed pile 17 installed in a state preventing clogging of soil 91a during screw in.

[0125]

Note that, in the state where the screwed pile 17 penetrates down to the bearing layer 92 and the screwed pile 17 is stopped (state where screwed pile 17 penetrates down to predetermined depth of bearing layer 92 and installation work on the screwed pile 17 is completed), the inside of the screwed pile 17 is preferably clogged with soil 91a. In this case, a bearing force is obtained by the clogging of soil 91a, so the stability of the screwed pile 17 is improved. Note that, to obtain such a screwed pile 17, the method of installation of the screwed pile in the present embodiment may be used to drive the screwed pile 17 down to a predetermined depth of the bearing layer 92, then, for example, soil may be inserted inside of the screwed pile 17 to cause clogging. Further, it is more preferable that the screwed pile 17 be driven in and in that state soil 91a be packed inside of the screwed pile 17 to at least the thickness of the pile diameter upward from the pile tip.

[0126]

Note that, as the above-mentioned installation management device 6, a personal computer or other electronic device is used. The installation management device 6 is, for example, a known electronic device provided with a CPU (central processing unit), ROM (read only memory), RAM (random access memory), storage part, I/F, keyboard 6a, and monitor screen 6b and with the components connected to an internal bus. A worker can input or select various information or control commands etc. of the installation management device 6 through the keyboard 6a. A worker can recognize various types of information through, for example, a liquid crystal display or other monitor screen 6b.

[0127]

The CPU controls the installation management device 6 as a whole. The ROM stores the operating codes of the CPU. The RAM is a work region used at the time of operation of the CPU. The storage part stores pile information, basic pile information, and other various types of information. The storage part, for example, stores reference pile information etc. in advance. As the storage part, for example, an HDD (hard disk drive), SSD (solid state drive), or other known storage medium may be used. The functions performed by the installation management device 6 are realized by the CPU running programs stored in the storage part etc. using the RAM as a work region.

[0128]

Above, examples of embodiments of the present invention were explained in detail, but the above-mentioned embodiments all only show specific examples of working the present invention. The technical scope of the present invention must not be interpreted limited to these.

REFERENCE SIGNS LIST

[0129]

1: vertical load measuring device

	1a: load cell
	2: rotational angle measuring device
	2a: magnetic reaction proximity switch
	2b: metal piece
5	3: penetration measuring device
	3a: wire rope
	3b: encoder
	3c: stroke sensor
	4: rotational torque measuring device
10	4a: auger ammeter
	5: deviation measuring device
	5a: load cell
	6: installation management device
	6a: keyboard
15	6b: monitor screen
	6c: printer
	7: data converter
	8: interface box
	9: data input part
20	10: pile driver leader
	11: endless track
	12: turn table
	13: pile driver body
	14: inclined support arm
25	15: auger machine
	15a: body part
	15b: nonrotating frame member
	15c: rotation body
	16: helical blade
30	17: screwed pile
	18: distance meter
	19: driver's compartment
	21: casing driver
	21a: crawler crane
35	21b: reaction bar
	22: swivel ring

	23: hydraulic motor
	24: thrust jack
	24a: cylinder
	25: gripping part
5	26: pedestal
	27: nonrotating frame member
	28: gear mechanism
	29: bearing mechanism
	30: handle
10	41: bearing plate
	50: crane
	51: excavation device
	81: light wave distance meter
	83: clamp
15	84: light wave beam
	85: weight
	86: level measuring rope
	91: ground
	91a: soil
20	92: bearing layer
	93: hard soil
	100: installation management system
	S100: screw-in step
	S110: measurement step
25	S120: judgment step
	S121: unclogging step
	S122: movement step
	S123: confirmation step
	X: pile axis perpendicular direction
30	W: pile circumferential direction
	Z: pile axial direction

CLAIMS

[Claim 1]

A method of installation of driving a screwed pile provided with a blade into the ground,
the method of installation of the screwed pile characterized by comprising
5 a measurement step of measuring a vertical load in a screwed pile while screwing
the screwed pile into the ground and
a judgment step of judging whether to unclog soil deposited inside the screwed
pile based on the results of measurement of the vertical load obtained by the measurement step.

10 [Claim 2]

The method of installation of the screwed pile according to claim 1, characterized by the
measurement step including measuring at least one of a rotational torque of the screwed pile and
amount of penetration.

15 [Claim 3]

The method of installation of the screwed pile according to claim 1 or 2 characterized in
that the judgment step includes comparing the past results of measurement at the time of
screwing in screwed piles installed in the past and the results of measurement obtained by the
measurement step and judging whether to unclog the soil.

20

[Claim 4]

The method of installation of the screwed pile according to any one of claims 1 to 3
characterized by further comprising a step of making the screwed pile reverse and rotate in an
extraction direction while screwing in the screwed pile and a step of measuring a vertical load at
25 the screwed pile while rotating in the extraction direction and by judging whether the clogging of
soil deposited in the screwed pile has been eliminated based on the results of measurement of the
vertical load during rotation in the extraction direction.

[Claim 5]

30 The method of installation of the screwed pile according to claim 4 characterized in that
the step of making the screwed pile rotate in reverse is performed when judging in the judgment
step to unclog the soil.

[Claim 6]

35 The method of installation of the screwed pile according to any one of claims 1 to 3
further comprising an unclogging step of using an excavation device to remove at least part of

the soil and unclog the soil when judging in the judgment step to unclog the soil.

[Claim 7]

5 The method of installation of the screwed pile according to claim 6 characterized by further comprising, after screwing in the screwed pile down to the bearing layer, a movement step of making the soil removed using the excavation device move to the inside of the screwed pile.

[Claim 8]

10 The method of installation of the screwed pile according to any one of claims 5 to 7 characterized in that the measurement step includes measuring an amount of deposition of soil deposited inside the screwed pile.

[Claim 9]

15 The method of installation of the screwed pile according to claim 8 characterized by further comprising, after the unclogging step, a confirmation step of measuring the amount of deposition to confirm whether the soil has been unclogged.

[Claim 10]

20 A method of production of a group of piles characterized by using the method of installation of a screwed pile according to any one of claims 1 to 9 to produce a group of piles including a plurality of screwed piles driven down to a bearing layer of the ground.

[Claim 11]

25 A group of pile characterized by including a plurality of screwed piles produced by the method of production of a group of piles in claim 10 and driven down to a bearing layer of the ground.

[Claim 12]

30 A group of piles characterized by soil clogging the inside of a screwed pile in a state with the pile driven down to a bearing layer of the ground in claim 11.