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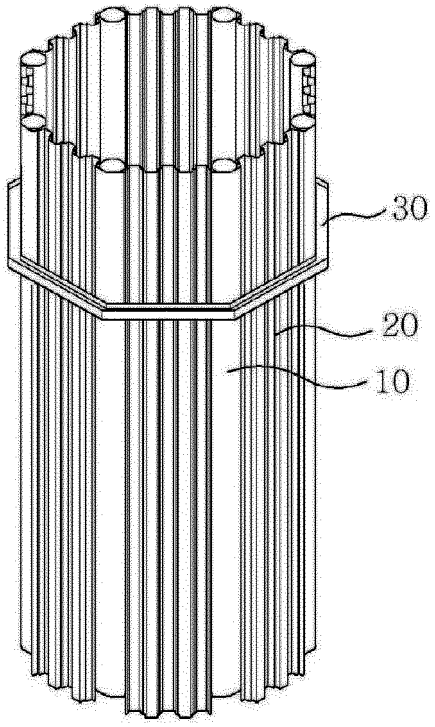
(54) BATCH-INSTALLATION-TYPE LARGE-CALIBER UNDERWATER CASING INSTALLATION STRUCTURE USING SHEET PILE AND METHOD FOR CONSTRUCTING SAME

(57) The present invention relates to a large-caliber casing installation construction for preventing a collapse or an inflow of an earth layer during excavation of the ground for laying a foundation in the process of building a underwater structure, such as a dam, a bridge, an off-shore wind structure under water, such as sea and river. The present invention completes a casing structure by installing a sheet pile between steel pipes and insertingly installing a center piles inside the steel pipes, and as a result, enables batch installation after first assembling the casing structure, and thus, can reduce field work and flexibly respond to irregular grounds underwater during construction.

【Fig.4】



Assembly

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Description

[0001] The present invention relates to a large-caliber casing construction for preventing a collapse or an inflow of an earth layer during excavation of the ground for laying a foundation in the process of building a underwater structure, such as a dam, a bridge, and an offshore wind structure under water, such as sea and river, and more particularly, to a temporary structure of a large-caliber casing type and a method of constructing the same, which enables batch installation after prefabrication to thereby reduce field work and can flexibly cope with irregular underwater ground.

Background Art

[0002] In order to stably construct an underwater structure, such as a dam, a bridge, and an offshore wind structure under water, such as sea and river, a stable foundation work on the underwater ground must be preceded. The foundation work of the underwater ground is carried out through a method of constructing mono piles after excavating the underwater ground. Before excavation of the underwater ground, it is necessary to install a temporary structure of a large-caliber casing type in the foundation work area in order to prevent an inflow of weak soil or water into the foundation work area or a collapse of the underwater ground. A method of embedding large-caliber casing steel pipes (large-caliber steel pipe pile type) is a representative method of constructing temporary structures.

[0003] The large-caliber steel pipe pile type is a method of manufacturing integrally large-caliber casing steel pipes with steel materials around a factory or a construction field, carrying the manufactured steel pipes into the construction field and constructing them while sinking them in water. Such a method can reduce field work but has several problems in that it needs large-scale equipment for carrying and lifting the large-sized casing steel pipes and in that stabilization work of the underwater ground must be previously carried out in order to stably settle and install the casing steel pipes in the underwater ground. Moreover, in the case that the underwater ground is developed irregularly, for instance, the bedrock is exposed or the earth layer is distributed very thinly, because the casing steel pipes cannot flexibly cope with the underwater ground, the method cannot prevent a collapse or an inflow of an earth layer while the casing steel pipes excavate the underwater ground.

Disclosure

Technical Problem

[0004] Accordingly, the present invention has been made in an effort to solve the above-mentioned problems occurring in the prior arts, and it is an object of the present invention to provide a temporary structure of a large-caliber casing type and a method of constructing the same, which enables batch installation after prefabrication to thereby reduce field work and can flexibly cope with irregular underwater ground.

Technical Solution

[0005] To achieve the above objects, the present invention provides a underwater large-caliber casing structure which is completed by installing sheet piles between steel pipes through a claw connection method and a construction method of a large-caliber casing including the steps of prefabricating steel pipes and sheet piles, installing them in a lump, and embedding and installing center piles and the sheet piles in the ground under water.

Advantageous Effects

[0006] The temporary structure of the large-caliber casing type and the method of constructing the same according to the present invention have the following effects.

[0007] First, the large-caliber casing work can be carried out in the minimized field work because sheet piles are installed after being prefabricated. Accordingly, the present invention can reduce the construction period of time and construction expenses in relation with foundation work of the underwater structure.

[0008] Second, because the underwater large-caliber casing is constructed in such a manner that the sheet piles and the steel pipes are first installed in an assembled state and H-piles are installed inside the steel pipes of the assembled body, there is little possibility to cause a construction error, and as a result, the present invention can enhance the construction quality due to a schemeful construction.

[0009] Third, because the present invention can install sheet piles while coping with an irregular underwater ground even though the surface of a hard layer (or a rock layer) on the seabed or a riverbed is in a very irregular state, it can prevent a collapse of soil during excavation of the underwater ground inside the casing for laying the foundation.

Description of Drawings

[0010]

FIGS. 1 and 2 are a plan view and a perspective view of a temporary underwater large-caliber casing structure according to the present invention.

FIG. 3 is a detailed diagram showing a connected state of a steel pipe and a sheet pile of the temporary underwater large-caliber casing structure according to the present invention.

FIGS. 4 to 7 are flow charts showing a construction method of the temporary underwater large-caliber casing structure according to the present invention.

FIGS. 8 to 10 are flow charts showing a process of constructing an underwater structure while applying the construction method of the temporary underwater large-caliber casing structure according to FIGS. 4 to 7, wherein the flow charts respectively show construction sequences of a mono-pile for offshore wind and a pier for a bridge.

Best Mode

[0011] The present invention provides a temporary batch-installation-type underwater large-caliber casing structure using sheet piles including: steel pipes having a plurality of claw connectors disposed on the outer peripheral surface thereof, the steel pipes being spaced apart from each other at predetermined intervals and installed in the ground under water in such a manner that the claw connectors are opposed to each other; sheet piles having a plurality of claw connectors disposed at end portions thereof, the sheet piles being installed in such a way as to close spaces between the steel pipes and being embedded in the ground under water while engaging with the steel pipes through the claw connectors; a horizontal strut fixed inside or outside the casing to horizontally connect the steel pipes; and center piles respectively inserted into the steel pipes and fixed to the steel pipes while being embedded into the ground under water.

[0012] The present invention provides a construction method of a temporary batch-installation-type underwater large-caliber casing structure including the steps of: (S11) assembling steel pipes, sheet piles and a horizontal strut in such a manner that the sheet piles are not located lower than the steel pipes; (S12) carrying the assembled body of the step (S11) into a construction field and seating the steel pipes on the ground under water; (S13) inserting and driving center piles into the steel pipes so as to embed them into the ground under water; (S14) fixing the center piles to the steel pipes; and (S15) driving the sheet piles so as to embed them into the ground under water.

Mode for Invention

[0013] Reference will be now made in detail to the preferred embodiment of the present invention with reference to the attached drawings.

[0014] FIGS. 1 and 2 are a plan view and a perspective view of a temporary underwater large-caliber casing structure according to the present invention. The underwater large-caliber casing is a temporary structure for preventing a collapse or an inflow of an earth layer during excavation of the ground for laying a foundation in the process of building an underwater structure, such as a dam, a bridge, and an offshore wind structure under water, such as sea and river. The underwater large-caliber casing assembling structure includes steel pipes 10, sheet piles 20, a horizontal strut 30, and center piles 50.

[0015] The steel pipe 10 is an empty hollow member and has a claw connector 13 disposed on the outer peripheral surface thereof. A plurality of the steel pipes 10 are arranged at predetermined intervals and are seated on the bottom under water in such a manner that the claw connectors 13 are opposed to each other. Such steel pipes 10 serve as a guide pipe of the center piles 50 respectively inserted and mounted inside the steel pipes.

[0016] The sheet piles 20 are sheet type pile members which respectively have claw connectors 23 disposed at ends thereof so as to be joined to each other through a claw connection, and are generally the same as typical sheet piles used for retaining walls or cofferdams. In other words, the sheet piles 20 are arranged in mutual claw connection one by one and are installed under the ground while being driven into the ground. The sheet piles 20 are embedded and installed to the underwater ground while being engaged and connected with the steel pipes 10 through the claw connectors 13 and 23 between the steel pipes 10 so as to form a casing of a closed structure together with the steel pipes 10.

[0017] The sheet piles 20 are joined one another in engagement with one another and with the steel pipes 10 so as to close spaces between the steel pipes 10 by the sheet piles 20.

[0018] The horizontal strut 30 is fixedly mounted while horizontally connecting the steel pipes 10 inside or outside the casing. A plurality of the steel pipes 10 are restricted and reinforced into one body by the horizontal strut 30. For a stable reinforcing structure, it is preferable that the horizontal strut 30 includes an outer strut 31 which is continuously mounted from the outside of the casing. The horizontal strut 30 is fixed only to the steel pipes 10 and simply gets in contact with the sheet piles 20, such that the sheet piles 20 can be embedded and installed in the underwater ground while being driven even in a state where the steel pipes 10, the horizontal strut 30 and the sheet piles 20 are assembled together. In the meantime, the horizontal strut 30 may be disposed parallel to each other in multistage, and in this instance, vertical strut 40 may be additionally disposed for vertically connecting the multistage horizontal strut 30. The horizontal strut 30 and the vertical strut 40 may be adopted from general steel members having a proper cross section, such as H-shaped steels, □-shaped channels, angles, and others, according to structural designs, and FIG. 1 illustrates the outer strut 31 having the H-shaped steel and the vertical strut 40 having the □-shaped channel.

[0019] The center pile 50 is inserted into the steel pipe 10 and fixed to the steel pipe 10 while being embedded to the underwater ground. The center piles 50 are embedded and mounted in the underwater ground together with the sheet piles 20 and serve to stably settle the temporary casing structure to the underwater ground. It is possible that the center piles 50 are embedded deeper than the sheet piles 20 if possible because the center piles 50 are H beams. Preferably, the center piles 50 are

properly adopted from general steel members, such as H-shaped steels, and FIG. 1 illustrates the center piles 50 having the H-shaped steels. Meanwhile, the center piles 50 are fixed to the steel pipes 10, and for this, couplers may be used properly. Considering that the underwater large-caliber casing according to the present invention is the temporary structure which will be demolished before long, it is preferable that the couplers are mounted by a wedge type fixing method or a bolt fastening method so as to be easily attached and detached rather than the welding method.

[0020] Through the above structure, the temporary underwater large-caliber casing structure is finished. The casing of the closed structure is completed through the claw connection of the steel pipes 10 and the sheet piles 20, and the temporary structure can keep a stable construction state through settlement of the center piles 50 and the sheet piles 20 in the underwater ground. The temporary underwater large-caliber casing structure according to the present invention may have a circular closed structure or a polygonal closed structure.

[0021] FIGS. 1 and 2 show a temporary casing structure of the polygonal closed structure. As shown in the drawings, the steel pipes 10 are arranged in such a way as to be located at edges of a polygon and the sheet piles 20 are arranged in such a way as to be located as sides of the polygon to thereby complete the polygonal closed structure. The polygonal closed structure can be easily completed when general straight steel members are applied as the horizontal struts 30 as they are.

[0022] Furthermore, in FIGS. 1 and 2, the horizontal strut 30 has inner and outer struts 31 and 32 which are spaced apart from each other and respectively mounted in parallel with each other inside and outside the casing, and the sheet piles 20 are contactingly mounted between the inner and outer struts 31 and 32. Such an installation structure of the horizontal strut 30 is favorable in securing a stable reinforcing structure by the inner and outer struts 31 and 32 and keeping perpendicularity of the sheet piles 20 during the process of embedding and installing the sheet piles 20.

[0023] FIG. 3 is a detailed diagram showing a connected state of a steel pipe and a sheet pile of the temporary underwater large-caliber casing structure according to the present invention. In FIG. 3, the steel pipes 10 are formed by properly transforming conventional steel pipes. Concretely, the steel pipe 10 includes: a steel pipe body 11; a wing sheet 12 welded on the outer peripheral surface of the steel pipe body 11; and a claw connector 13 formed by an end portion of the wing sheet 12 curved. In other words, the sheet pile 20 is divided in half and joined to both sides of the steel pipe body 11, such that the steel pipe 10 having the claw connector 13 is completed. The steel pipe 10 is simply joined during the claw connection of the sheet pile 20.

[0024] FIGS. 4 to 7 are flow charts showing a construction method of the temporary underwater large-caliber casing structure according to the present invention, and illustrate the method of constructing the temporary underwater large-caliber casing structure of FIGS. 1 and 2. Now, the construction method of the temporary underwater large-caliber casing structure according to the present invention will be described.

[0025] First, the steel pipes 10, the sheet piles 20 and the horizontal strut 30 are assembled, and the vertical struts 40 may be further assembled in the case that the vertical struts 40 are installed (S11, See FIG. 4). The sheet piles 20 are equal to or longer than the steel pipes 10, and preferably, are not located lower than the steel pipes 10. The reason is not to be interfered by the sheet piles 20 and to stably install the steel pipes 10 in the ground under water.

[0026] Next, the assembled body assembled in the step S11 is carried into a construction field, and the steel pipes 10 are seated and installed in the ground under water (S12, See FIG. 5). The steel pipes 10 are installed while being lifted by a crane, and the assembled body is held not to be moved after the installation.

[0027] Next, the center piles 50 of the H-shaped steels are inserted and driven into the steel pipes 10 so as to be embedded in the ground under water (S13, See FIG. 6). After that, the center piles 50 are fixed in the steel pipes 10 (S14), and the sheet piles 20 are driven to be embedded and installed in the ground under water (S15, See FIG. 7). In this instance, a crane, a hammer, or others may be used properly.

[0028] Through the above steps, the temporary large-caliber casing structure is completely constructed. Because arrangement of the previously assembled body, insertion and driving of the center piles 50, and driving of the sheet piles 20 are just carried out in the construction field, the present invention can reduce a work amount in the construction field and allow rapid construction work.

[0029] FIGS. 8 to 10 are flow charts showing a process of constructing an underwater structure while applying the construction method of the temporary underwater large-caliber casing structure according to FIGS. 4 to 7, wherein the flow charts respectively show construction sequences of a mono-pile for offshore wind and a pier for a bridge.

[0030] FIGS. 8 and 9 illustrate a construction sequence of the mono-pile (MP). First, the temporary underwater large-caliber casing structure is constructed in a construction position (See FIG> 8), and the construction method is the same as FIGS. 4 to 7. A drilling rig is inserted into the temporary casing structure and fixed to the top of a jackup barge, and then, a drilling base machine and the drilling rig are connected with each other so as to drill the inside of the temporary casing structure (See FIG. 9(a)). In this instance, drilling water is supplied to the inside of the temporary casing structure in a reverse cycle, and then, drilling water and rock fragments are discharged out through a drill pipe. Next, the mono-pile (MP) is inserted and installed inside an excavation hole (FIG. 9(b)), various grouting materials, such as concrete, mortar, or other filling materials, fill between the mono-

pile and the excavation hole (FIG. 9(c)), and then, the temporary casing structure is removed (FIG. 9(d)). The removal work is carried out in reverse. In other words, first, the sheet piles 20 are drawn out from the ground under water, the fixed state of the center piles 50 is released to draw out the center piles 50 from the ground under water and remove the center piles 50 from the steel pipes 10, and then, the assembled body of the steel pipes 10, the sheet piles 20 and the horizontal strut 30 is lifted and carried. Through the above process, the underwater structure like the mono-pile can be constructed completely.

[0031] FIG. 10 illustrates a construction sequence of a pier under water. In order to construct the underwater pier, as shown in FIG. 8, first, the temporary underwater large-caliber casing structure is constructed at the construction position. Next, water is supplied to the inside of the temporary casing structure by a water lift pump (FIG. 10(a)), and then, when the underwater ground is exposed inside the temporary casing structure, a foundation of the pier (P1) and a pier body (P2) are constructed in the ground under water (FIGS. 19(b) and (c)). Next, after water is supplied to the inside the temporary casing structure (FIG. 10(d)), the temporary casing structure is removed (FIG. 10(e)). In this instance, the removal of the temporary structure is the same as the construction process of the mono-pile described above. Through the above process, the underwater structure such as the pier of the bridge is constructed completely.

[0032] As described above, while the present invention has been particularly shown and described with reference to the example embodiments thereof, it will be understood by those of ordinary skill in the art that the above embodiments of the present invention are all exemplified and various changes, modifications and equivalents may be made therein without departing from the scope of the present invention. Therefore, it would be understood that the technical and protective scope of the present invention shall be defined by the technical idea as defined by the following claims.

Claims

1. A temporary batch-installation-type underwater large-caliber casing structure using sheet piles comprising:

   steel pipes (10) having a plurality of claw connectors (13) disposed on the outer peripheral surface thereof, the steel pipes (10) being spaced apart from each other at predetermined intervals and installed in the ground under water in such a manner that the claw connectors (13) are opposed to each other;
   sheet piles (20) having a plurality of claw connectors (23) disposed at end portions thereof, the sheet piles (20) being installed in such a way as to close spaces between the steel pipes (10) and being embedded in the ground under water while engaging with the steel pipes (10) through the claw connectors (13, 23);
   a horizontal strut (30) fixed inside or outside the casing to horizontally connect the steel pipes (10); and
   center piles (50) respectively inserted into the steel pipes (10) and fixed to the steel pipes (10) while being embedded into the ground under water.

2. The temporary batch-installation-type underwater large-caliber casing structure according to claim 1, wherein the horizontal strut (30) comprises: an outer strut (31) located outside the casing; and an inner strut (32) located inside the casing, and the inner and outer struts (31, 32) are spaced apart from each other and arranged in parallel with each other, and wherein the sheet piles (20) get in contact with the inner and outer struts (31, 32).

3. The temporary batch-installation-type underwater large-caliber casing structure according to claim 1 or 2, wherein the steel pipe (10) comprises: a steel pipe body (11); a wing sheet (12) welded on the outer peripheral surface of the steel pipe body (11); and a claw connector (13) formed by an end portion of the wing sheet 12 curved.

4. The temporary batch-installation-type underwater large-caliber casing structure according to claim 1 or 2, wherein the steel pipes (10) are arranged at edges of a polygonal composition,
   the sheet piles (20) are arranged on sides of the polygonal composition while connecting the steel pipes (10) with each other, and
   the horizontal strut (30) comprises an outer strut (31) mounted in a polygonal composition while surrounding the outer periphery of the steel pipes (10).

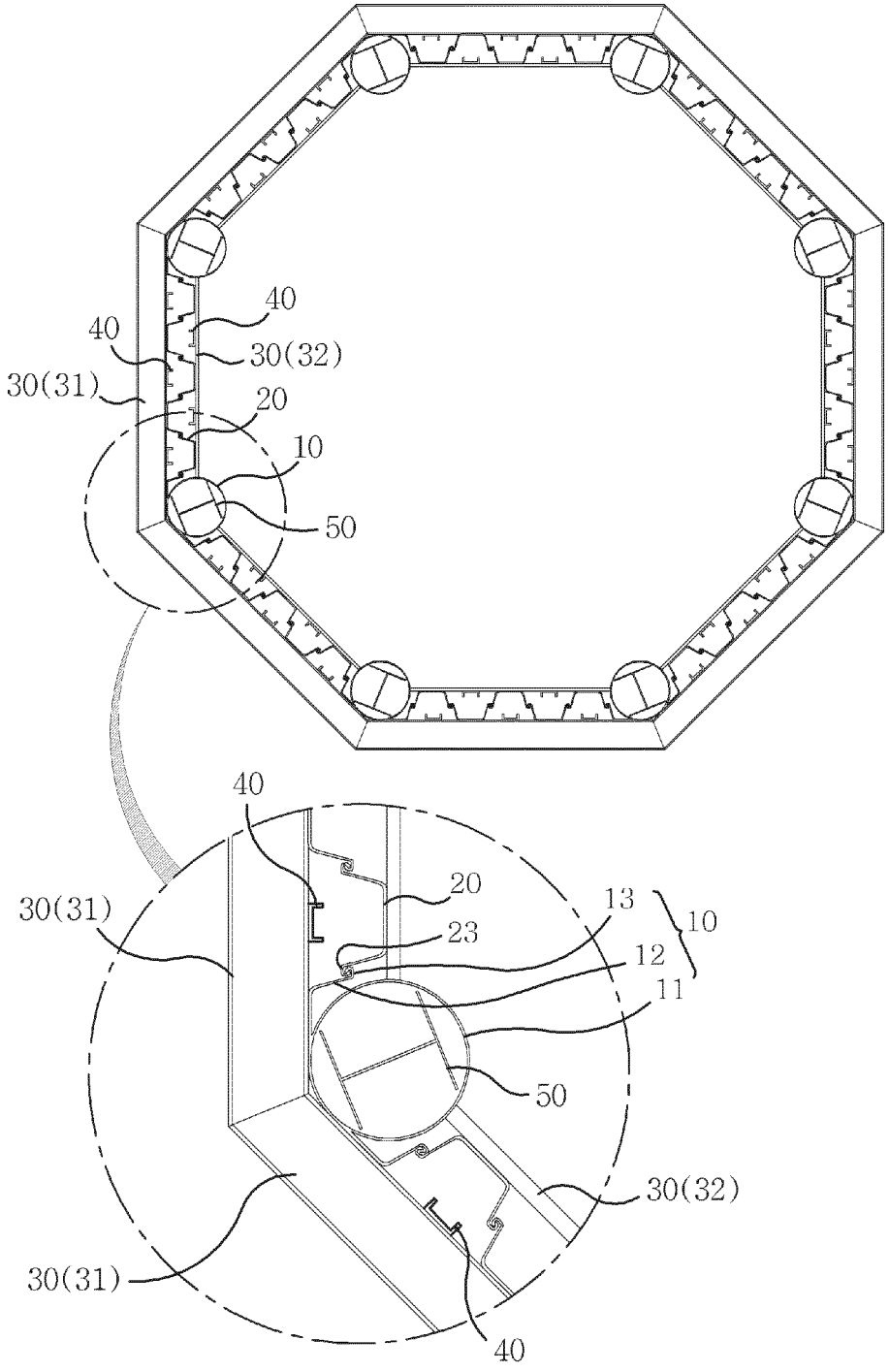
5. The temporary batch-installation-type underwater large-caliber casing structure according to claim 1 or 2, wherein the center piles (50) are H-shaped steels.

6. A construction method of the temporary batch-installation-type underwater large-caliber casing structure according to claim 1 or 2, comprising the steps of:

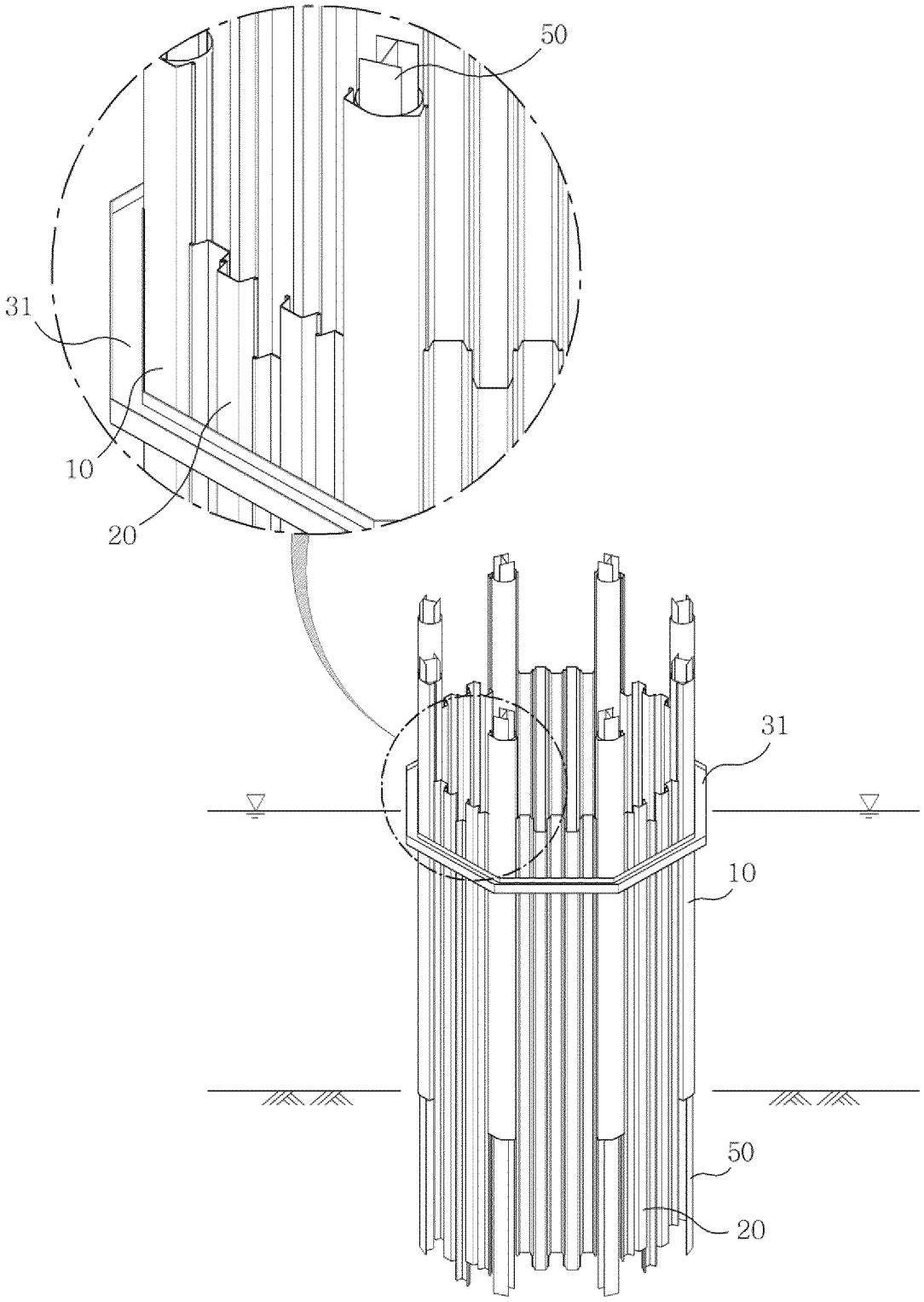
   (S11) assembling steel pipes (10), sheet piles (20) and a horizontal strut (30) in such a manner that the sheet piles (20) are not located lower than the steel pipes (10);
   (S12) carrying the assembled body of the step (S11) into a construction field and seating the steel pipes (10) on the ground under water;
   (S13) inserting and driving center piles (50) into

the steel pipes (10) so as to embed them into the ground under water;
(S14) fixing the center piles (50) to the steel pipes (20); and
(S15) driving the sheet piles (20) so as to embed them into the ground under water.

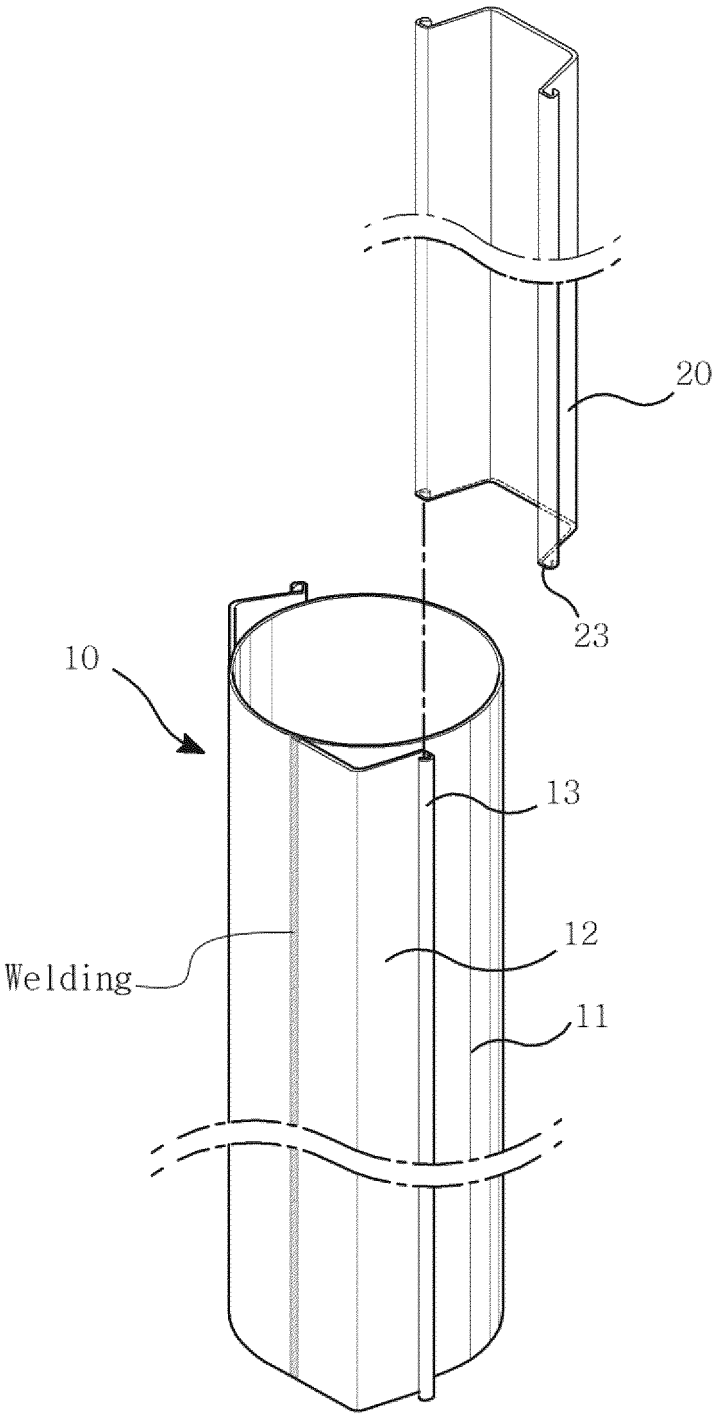
【Fig.1】



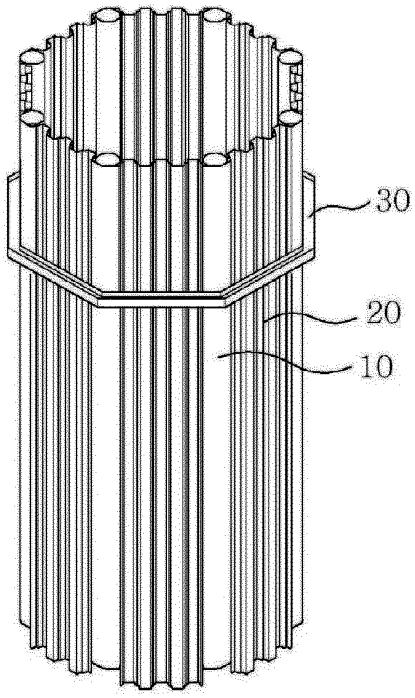
【Fig.2】



【Fig.3】

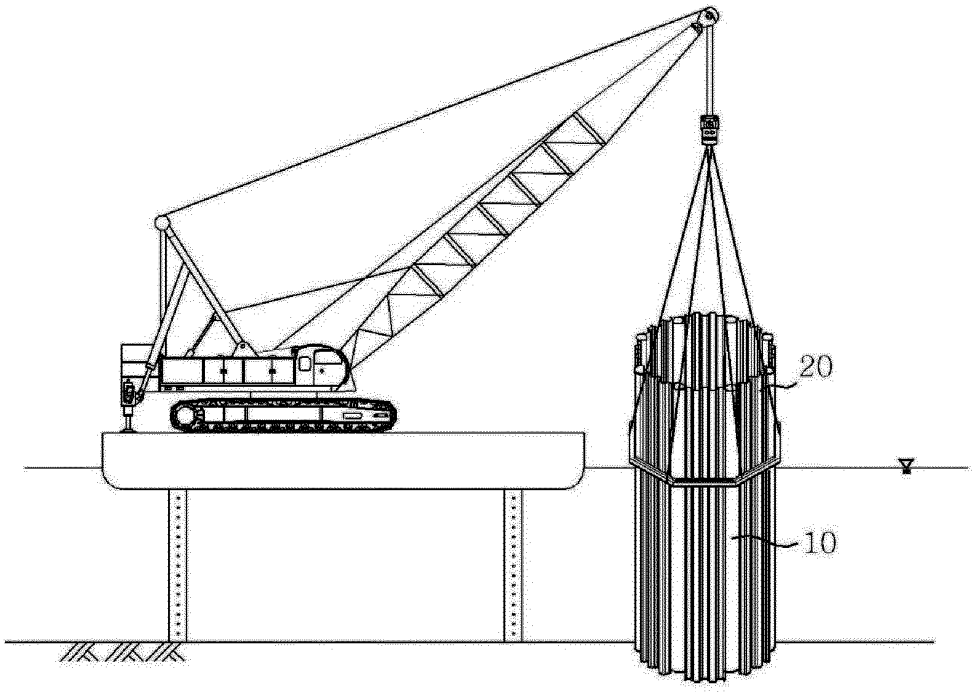


【Fig.4】



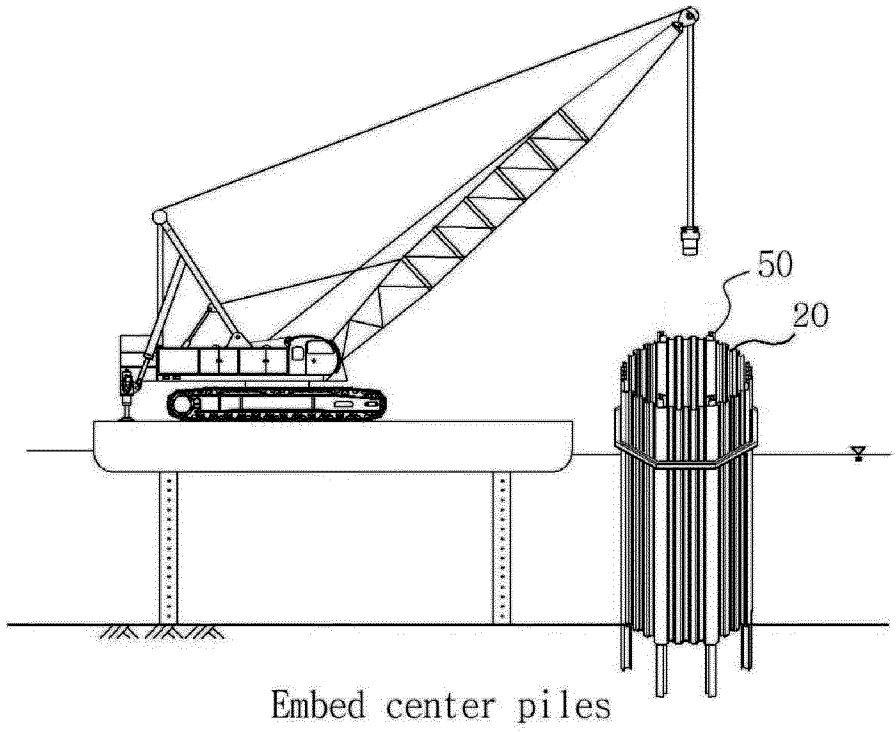
Assembly

【Fig.5】

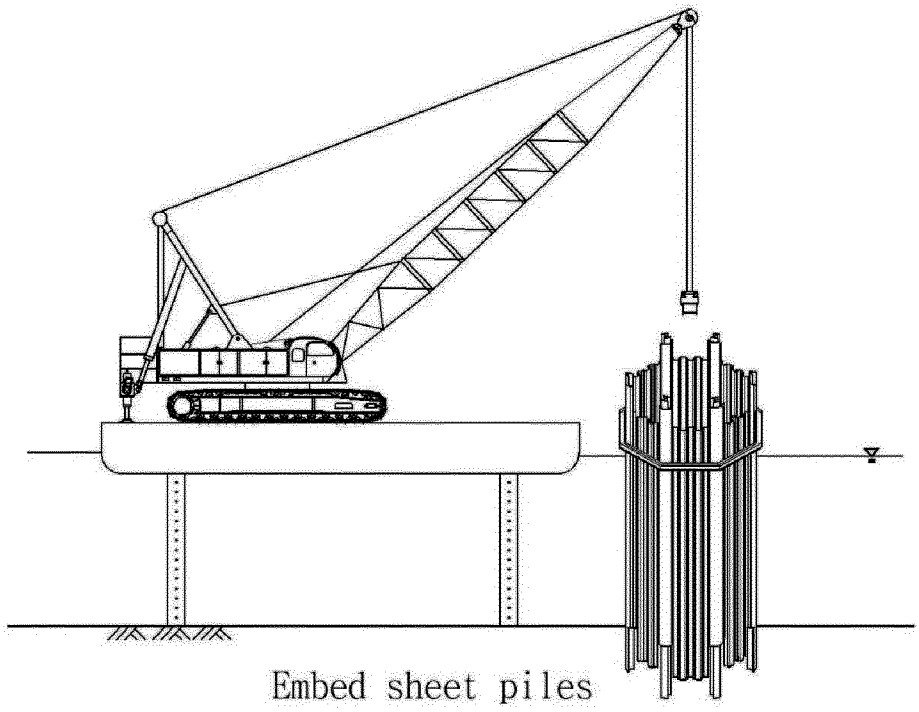


Seat assembled body

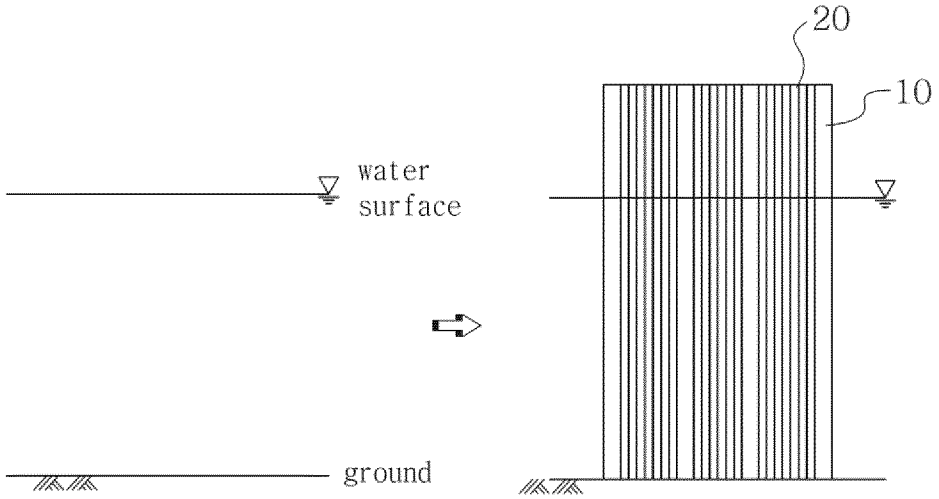
【Fig.6】



【Fig.7】

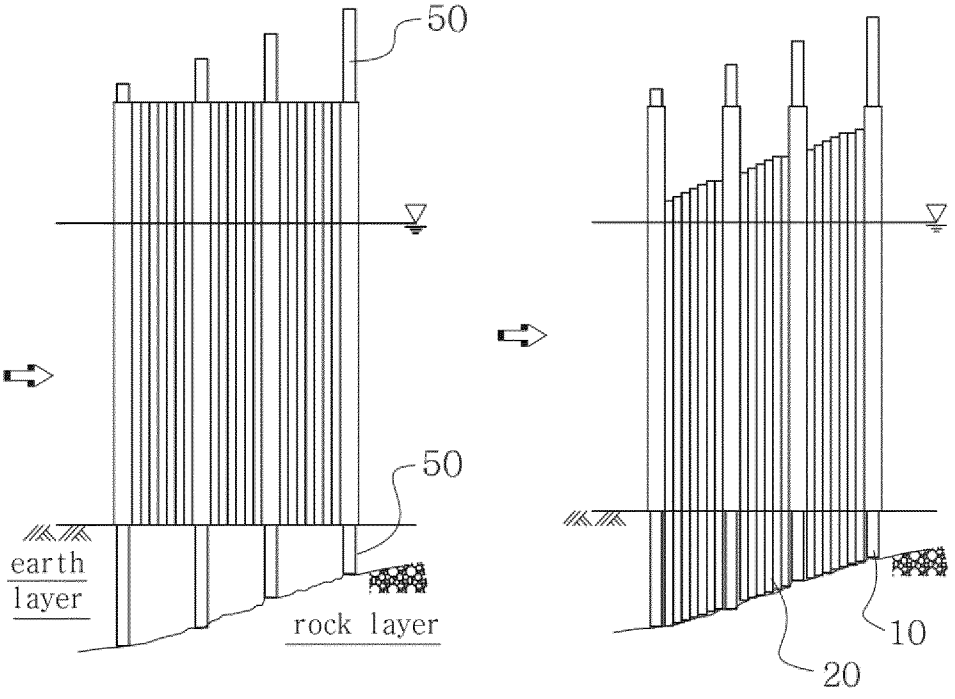


【Fig.8】



(a) Prepare in construction field

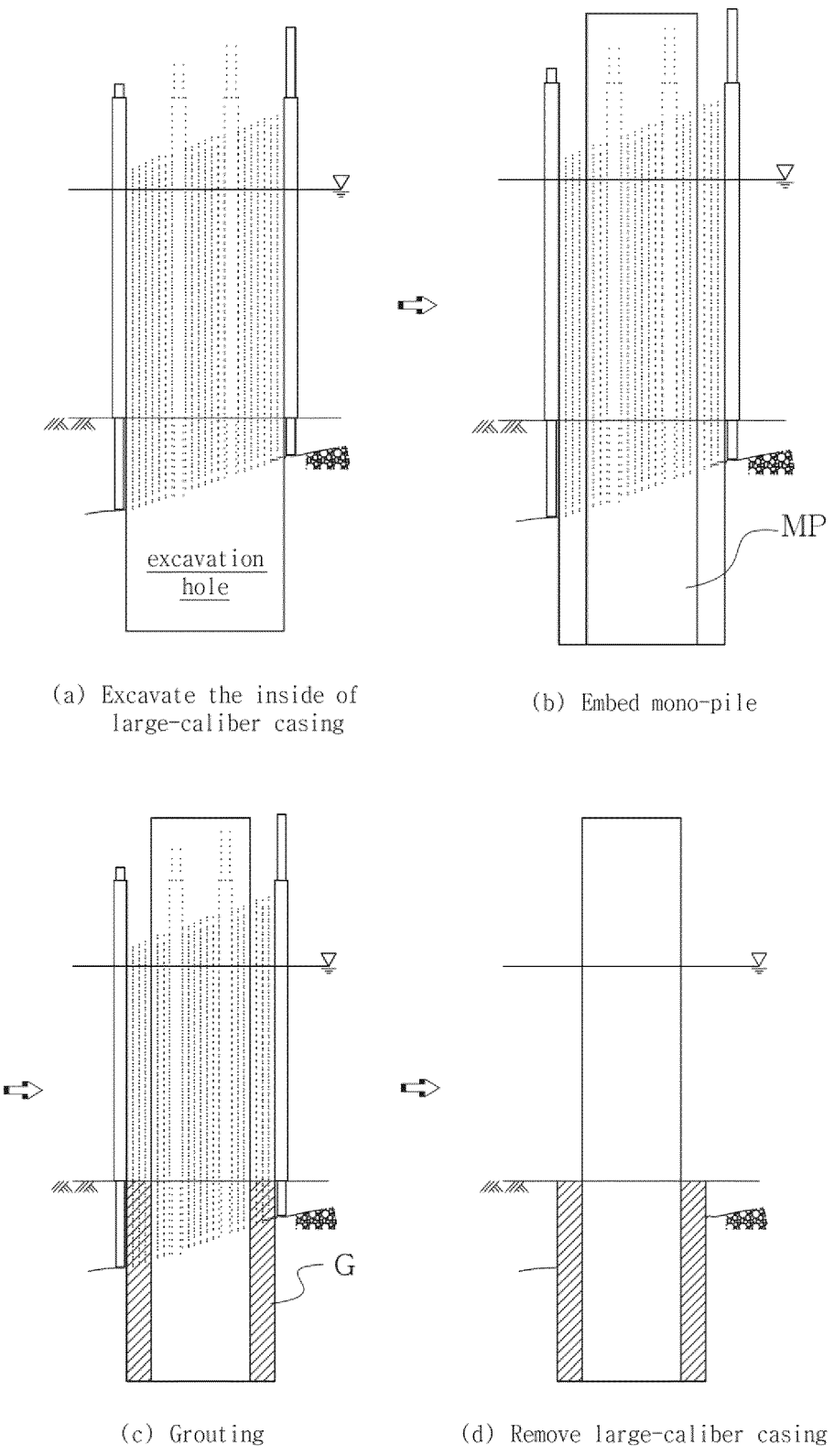
(b) Seat assembled body



(c) Embed center piles

(d) Embed sheet piles
(complete construction of
large-caliber casing)

【Fig.9】



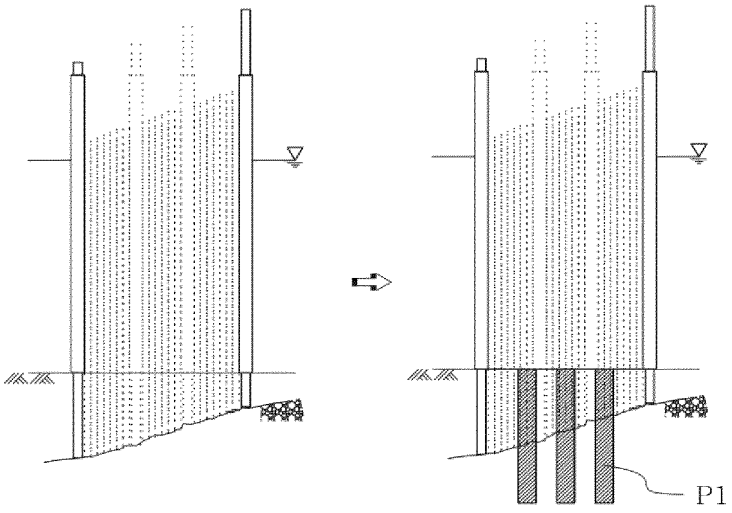
(a) Excavate the inside of large-caliber casing

(b) Embed mono-pile

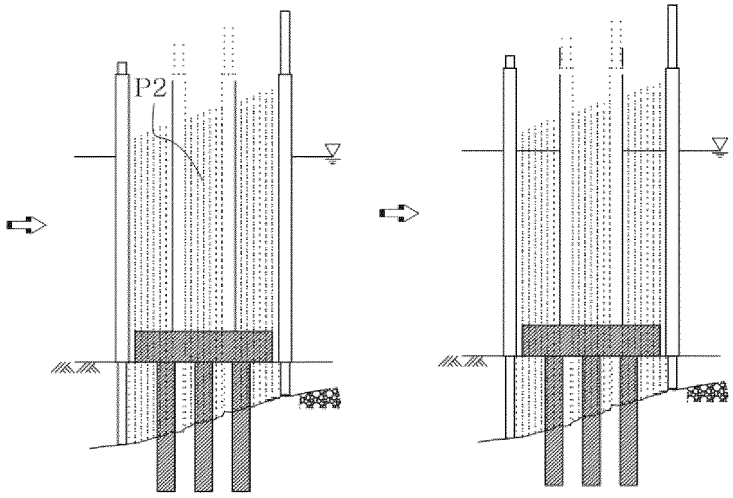
(c) Grouting

(d) Remove large-caliber casing

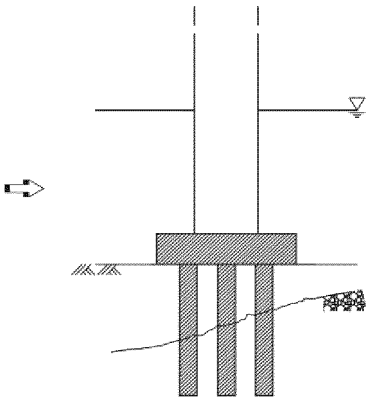
【Fig.10】



(a) Water lifting (b) Foundation construction



(c) Body construction (d) Water supply



(e) Remove large-caliber casing

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2011/009993

A. CLASSIFICATION OF SUBJECT MATTER

E02D 19/02(2006.01)i, E02D 27/18(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)

E02D 19/02; E02D 23/00; E02D 29/09; E02D 5/04; E02D 23/02; E02D 27/18; E02D 5/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: casing, caisson, steel pipe, sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2009-0037114 A (HYUNDAI CONSTRUCTION CO., LTD. et al.) 15 April 2009 See abstract and figures 4c-4e.	1-6
A	KR 10-2009-0089832 A (HYUNDAI ENGINEERING CO., LTD.) 24 August 2009 See claim 1 and figures 18, 20.	1-6
A	KR 10-0884289 B1 (GAWON ENGINEERING & CONSTRUCTION et al.) 17 February 2009 See abstract and figures 1, 2.	1-6
A	KR 10-2009-0042677 A (SAMSUNG C&T CORPORATION) 30 April 2009 See abstract and figures 1, 10.	1-6
A	KR 10-2006-0102837 A (JAE HYUN CONSTRUCTION CO.,LTD.) 28 September 2006 See abstract and figure 3.	1-6

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 JULY 2012 (18.07.2012)	**18 JULY 2012 (18.07.2012)**
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