

DESCRIPTION

TITLE OF THE INVENTION: CONSTRUCTION PROCESS OF OFFSHORE BRIDGE HIGH-RISE PILE PLATFORM

TECHNICAL FIELD

[0001] The present invention relates to a construction process of an offshore bridge high-rise pile platform.

BACKGROUND

[0002] A cross-sea bridge comprises several offshore piers and abutments and several onshore piers and abutments. The construction of the offshore piers and abutments involves first performing offshore pile foundation sinking, then constructing a platform on a pile foundation, followed by building pier columns on the platform, and finally erecting main girders between the pier columns. The offshore piers and abutments located in the middle of a water area, due to their positions in deep water and navigation areas, have maximum planar dimensions for the platform and maximum heights for the pier columns. In order to consume and absorb the impact force generated during ship collision, change navigation directions of ships, and protect the bridge body structure and the ships from damage, the offshore piers and abutments located in the middle of the water area should also have anti-collision measures, that is, surrounding the outer side of the platform with a circle of anti-collision piers. Currently, the platform located in the middle of the water area needs to be constructed underwater, which makes construction operations inconvenient. Therefore, it is necessary to develop a construction process for an offshore platform located in the middle of the water area.

SUMMARY

[0003] An objective of the present invention is to overcome the shortcomings of the prior art by providing a construction process of an offshore bridge high-rise pile platform, which can greatly reduce the construction difficulty and can improve the construction

efficiency.

[0004] The objective of the present invention is achieved as follows: a construction process of an offshore bridge high-rise pile platform, where an involved platform comprises a main platform and a circle of anti-collision platform arranged on an outer side of the main platform, a spacing between the main platform and the anti-collision platform is A, and a circle of skirt plate extending into a bottom of the anti-collision platform by B is arranged on an outer side of the anti-collision platform; the main platform has a rectangular plane and is supported by twelve pile foundations arranged in three horizontal rows and four vertical columns; a plane of the circle of anti-collision platform is a non-regular octagon that is narrow in a vertical direction and wide in a horizontal direction, the anti-collision platform is supported by thirty-six pile foundations, and the pile foundations are cast-in-place piles; the construction process uses a cofferdam of a steel-concrete structure for construction, and the cofferdam consists of a cofferdam bottom plate prefabricated by means of reinforced concrete and a steel side formwork;

[0005] the construction process of an offshore bridge high-rise pile platform of the present invention comprises the following stages: a preparation stage, a cofferdam mounting stage, a cofferdam lowering stage, a cofferdam bottom plate blocking and water pumping stage, and a platform concrete pouring stage;

[0006] the preparation stage comprises the following steps: pile foundation casing sinking, cast-in-place pile construction, pile foundation casing pile head trimming, cofferdam bottom plate and skirt plate prefabrication, and steel side formwork manufacturing;

[0007] during implementation of the cofferdam bottom plate and skirt plate prefabrication step, the cofferdam bottom plate is divided into a plurality of rectangular prefabricated slabs, with each prefabricated slab covering 1 to 2 pile foundations; C-type wet joints are arranged between the prefabricated slabs, and overlapping reinforcing bars are reserved; primary stepped pile holes with a large top and small bottom are reserved on each prefabricated slab based on positions of the pile foundations; during prefabrication, a hanging rod is pre-embedded at each of four corners of each prefabricated slab; and after the prefabrication of the prefabricated slabs is completed, an angle steel bracket for supporting the steel side formwork is mounted on an outer side surface of each prefabricated slab located at an edge of the cofferdam bottom plate using pre-embedded bolts;

[0008] the steel side formwork is composed of a plurality of side mold plates spliced together; a bottom of each side mold plate is supported on the angle steel bracket, and each side mold plate is supported by a diagonal bracing, of which a lower end is fixed on the cofferdam bottom plate, to be in a vertical state;

[0009] the cofferdam mounting stage comprises first, mounting the cofferdam bottom plate, and then mounting the steel side formwork, where the cofferdam bottom plate is mounted by means of suspension hangers, and each suspension hanger comprises a pile cap, an inverted hanging beam, and two first finish-rolled twisted steel bars; the pile caps are mounted at tops of pile foundation casings; the inverted hanging beam is arranged directly above the pile holes in a prefabricated bottom plate; lower ends of the two first finish-rolled twisted steel bars are pre-embedded onto the prefabricated slab and are located centrosymmetrically on an outer side of each pile hole, and upper parts of the two first finish-rolled twisted steel bars are each anchored at both ends of the inverted hanging beam through gaskets and sleeves in a one-to-one correspondence manner;

[0010] mounting of the cofferdam bottom plate comprises the following steps:

[0011] step 1, first mounting a floatable gap blocking bottom formwork between the pile holes of the cofferdam bottom plate and the pile foundation casings on the pile foundation casings, and then mounting the pile caps at top ends of the pile foundation casings;

[0012] step 2, first connecting a crane of a crane ship to a rectangular frame-type hanger, then connecting the hanger to four hanging rods on the prefabricated slabs, then using the crane of the crane ship to hang the prefabricated slabs to a position above a corresponding pile foundation casing and sleeve the pile holes in the prefabricated slabs onto the corresponding pile foundation casing; and then, lowering the prefabricated slabs until the inverted hanging beam on the prefabricated slabs rests on the corresponding pile cap, then welding and fixing the inverted hanging beam with the pile cap, and finally, enabling the hanger to be separated from the hanging rods, and supporting the prefabricated slabs by the suspension hangers to ensure that the prefabricated slabs are located above a water surface;

[0013] step 3, mounting the remaining prefabricated slabs one by one in accordance with step 2 until the mounting of the entire cofferdam bottom plate is completed; and

[0014] step 4, first welding the overlapping reinforcing bars of the wet joints between each prefabricated slab, and then pouring concrete into the wet joints to form a complete cofferdam bottom plate;

[0015] mounting of the steel side formwork involves: first mounting two layers of water-

stopping expansion rubber plates on a top surface of the angle steel bracket located on an outer side surface of the cofferdam bottom plate, then mounting the side mold plates one by one on the top surface of the angle steel bracket, where adjacent side mold plates are spliced using two columns of bolts, and a water-stopping rubber strip is arranged between and on both sides of the two columns of the bolts on a spliced surface, respectively; the steel side formwork is connected to the angle steel bracket through a plurality of vertical pull rods that are arranged at intervals, a layer of water-stopping expansion rubber plate is arranged between an inner side surface of a lower part of the steel side formwork and a lower part of the spliced surface of the cofferdam bottom plate, and a gap between the inner side surface of the lower part of the steel side formwork and an upper part of the spliced surface of the cofferdam bottom plate is filled with structural adhesive; and then, the lower end of the diagonal bracing of each side mold plate is fastened onto the cofferdam bottom plate;

[0016] the cofferdam lowering stage comprises the following steps:

[0017] step 1, mounting a jack lowering system on the cofferdam bottom plate, where the jack lowering system comprises I-shaped hangers, carrying pole beams, center hole jacks, and steel strands; the I-shaped hangers are fixed onto the cofferdam bottom plate through four second finish-rolled twisted steel bars that are pre-embedded onto the cofferdam bottom plate and are located between two inverted hanging beams; the carrying pole beams are erected between middle parts of top surfaces of the two inverted hanging beams; the center hole jacks are arranged at middle parts of top surfaces of the carrying pole beams; and lower ends of the steel strands sequentially pass through the center hole jacks and the carrying pole beams and are then anchored at middle parts of waists of the I-shaped hangers;

[0018] step 2, first mounting two back bracing rods on an outer side of each pile foundation casing, where bottoms of the back bracing rods are fixed onto the cofferdam bottom plate through bolts, and upper ends of the back bracing rods are free; and

[0019] step 3, first loosening sleeves anchoring the first finish-rolled twisted steel bars on each suspension hanger to the inverted hanging beams, and then using a plurality of center hole jacks in the jack lowering system to hang the entire cofferdam downwards into water in a step-by-step manner until a top elevation of the cofferdam bottom plate reaches a designed bottom elevation of the platform;

[0020] the cofferdam bottom plate blocking and water pumping stage comprises the following steps:

[0021] step 1, after the cofferdam is lowered into place, a top elevation of each back bracing rod being also lower than a top elevation of each pile foundation casing; first welding and fixing tops of the back bracing rods onto outer surfaces of the pile foundation casings, and then refastening the sleeves anchoring the first finish-rolled twisted steel bars on each suspension hanger to the inverted hanging beams to ensure that gravity of the cofferdam is borne by the suspension hangers again and buoyancy of the cofferdam is resisted by the back bracing rods, and then removing the jack lowering system;

[0022] step 2, during low tide, lifting a gap blocking bottom formwork pre-sleeved on the pile foundation casing upwards to tightly fit with the cofferdam bottom plate, then pouring a mixed mortar containing epoxy resin between the gap blocking bottom formwork and the cofferdam bottom plate, and solidifying for 1 hour so as to complete spacing blocking between each pile foundation casing and corresponding pile holes in the cofferdam bottom plate; and

[0023] step 3, pumping out all water in the cofferdam to form dry work construction conditions;

[0024] the platform concrete pouring stage comprises the following steps:

[0025] step 1, welding a plurality of shear keys along a circumference in a uniformly distributed manner on a peripheral surface of each pile foundation casing, where inner side ends of the plurality of shear keys are welded and fixed onto the outer surface of each pile foundation casing, and lower ends of the plurality of shear keys are bolted and fixed onto step surfaces of the pile holes of the cofferdam bottom plate;

[0026] step 2, first removing the back bracing rods and the suspension hangers to ensure that the entire cofferdam is supported by the shear keys; then, cutting the pile foundation casings to a designed top elevation, followed by using a rock splitting bar to drill 6-8 insertion holes radially along a pile head at a height of 300 mm above a designed elevation of a pile top, with depths of the insertion holes being 40-50 cm; and inserting a hydraulic flange separator into the insertion holes to separate concrete pile heads, and then hanging and removing detached concrete pile heads as a whole, and using a pneumatic pick to manually chisel off remaining concrete with a height of 300 mm on an upper part of the pile top;

[0027] step 3, first arranging a wood internal formwork between the main platform and the anti-collision platform to separate the main platform from the anti-collision platform, followed by binding reinforcing bars layer by layer in the cofferdam, and then pouring the concrete in three layers, where when a first layer of concrete and a second layer of

concrete is poured, the diagonal bracing of each side mold plate is poured in the concrete; after the second layer of concrete is completely poured, first mounting an opposite-pull screw on the side mold plate above the second layer of concrete, then cutting off the diagonal bracing of which a height is above a top surface of the second layer of concrete, and then pouring a third layer of concrete; and when the third layer of concrete is poured, controlling verticality of the side mold plate using the opposite-pull screw; and

[0028] step 4, first removing the steel side formwork, and then cutting the cofferdam bottom plate using a wire saw method to ensure that the cofferdam bottom plate is separated from the main platform and the anti-collision platform.

[0029] The construction process of an offshore bridge high-rise pile platform described above, where implementation of the cofferdam bottom plate and skirt plate prefabrication step comprises the following procedures:

[0030] 1) setting up a profile steel staging as a prefabricated bottom formwork for the prefabricated slabs;

[0031] 2) setting out positions of the pile holes in the prefabricated bottom formwork based on center coordinates of a pile foundation, and adjusting an elevation properly;

[0032] 3) binding the reinforcing bars inside the prefabricated slabs on the prefabricated bottom formwork, and mounting various pre-embedded parts properly, where the pre-embedded parts comprise four hanging rods that are arranged at the four corners of each prefabricated slab in a one-to-one correspondence manner;

[0033] 4) when prefabricating the prefabricated slabs located at the edge of the cofferdam bottom plate, mounting a skirt plate side formwork on the prefabricated bottom formwork, and fastening a split bolt between the skirt plate side formwork and the prefabricated bottom formwork properly; and

[0034] 5) pouring concrete, and removing the skirt plate side formwork and the prefabricated bottom formwork after 24 hours.

[0035] The construction process of an offshore bridge high-rise pile platform described above, where the gap blocking bottom formwork is composed of an annular wood mold plate, an annular foam bottom plate, and a rubber washer that are superposed from bottom to top.

[0036] The construction process of an offshore bridge high-rise pile platform described above, where implementation of step 2 of the cofferdam mounting stage further involves: observing elevations and horizontal positions of the prefabricated slabs, adjusting positions of the gaskets and the sleeves on the first finish-rolled twisted steel bars based

on observation results, adjusting an elevation deviation of the prefabricated slabs to ≤ 5 mm, and then using jacks arranged radially on the step surfaces of the pile holes to adjust a plane position deviation of the prefabricated bottom plate to ≤ 10 mm.

[0037] The construction process of an offshore bridge high-rise pile platform of the present invention has the following characteristics:

[0038] 1. The cofferdam of the steel-concrete structure is used, that is, the cofferdam bottom plate is composed of a plurality of concrete prefabricated slabs spliced together, and the steel side formwork is used as a cofferdam side formwork, such that the transportation of the entire cofferdam is more convenient, which is conducive to saving transportation space and transportation costs.

[0039] 2. Offshore mounting of the cofferdam does not require setting up a construction staging, but involves: first splicing the cofferdam bottom plate at a position above the water surface by using a suspension hanger system with the support of the pile foundation casings; then, mounting the cofferdam side formwork by using a spliced cofferdam bottom plate as the construction staging; then, lowering the entire cofferdam to a designed elevation in the water by using the jack lowering system; then, at a low water level, pumping out all water in the cofferdam and completing sealing between the cofferdam bottom plate and the pile foundation casings; and finally, sequentially binding the reinforcing bars and pouring the concrete in the cofferdam to complete the underwater construction of the cofferdam. The entire construction process is carried out in a waterless environment, which greatly reduces the construction difficulty and improves the construction efficiency.

[0040] 3. After the cofferdam is lowered into place, the shear keys are connected between the pile holes in the cofferdam bottom plate and the pile foundation casings. This not only avoids the horizontal movement of the cofferdam, but also disperses the weight of the entire cofferdam to the shear keys and transfers the weight to each pile foundation casing for support. It is beneficial to improve the bearing capacity of the cofferdam bottom plate and the platform, such that the cofferdam bottom plate and the platform are less likely to crack when bearing the weight of the bridge.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] FIG. 1a is a plan view of a high-rise pile platform involved in a construction process of the present invention;

[0042] FIG. 1b is a view taken along A1-A1 in FIG. 1B;

[0043] FIG. 1c is a view taken along A2-A2 in FIG. 1B;

[0044] FIG. 2a is a top view of a cofferdam involved in a construction process of the present invention;

[0045] FIG. 2b is a segmented schematic diagram of a cofferdam bottom plate involved in a construction process of the present invention;

[0046] FIG. 2c is a view taken along A-A in FIG. 2a;

[0047] FIG. 2d is an enlarged view of part P in FIG. 2c;

[0048] FIG. 3 is a top view of a suspension hanger used during a cofferdam mounting stage of a construction process of the present invention;

[0049] FIG. 4 is an elevation view of a jack lowering system used during a cofferdam lowering stage of a construction process of the present invention;

[0050] FIG. 5 is a plan layout diagram of a jack lowering system used during a cofferdam lowering stage of a construction process of the present invention;

[0051] FIG. 6 is an elevation view of a pull-and-support system used during a cofferdam bottom plate blocking and water pumping stage of a construction process of the present invention;

[0052] FIG. 7 is a schematic structural diagram of connection between shear keys and pile foundation casings used during a platform concrete pouring stage of a construction process of the present invention; and

[0053] FIG. 8 is a schematic diagram of a construction process of the present invention during a platform concrete pouring stage.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0054] the present invention is further described below with reference to the accompanying drawings.

[0055] Referring to FIG. 1 to FIG. 8, a construction process of an offshore bridge high-rise pile platform of the present invention, where an involved platform comprises a main platform 101 and a circle of anti-collision platform 102 arranged on an outer side of the main platform 101, a spacing between the main platform 101 and the anti-collision platform 102 is $A=0.8$ m, and a circle of skirt plate 103 extending into a bottom of the anti-collision platform 102 by $B=2$ m is arranged on an outer side of the anti-collision platform 102; the main platform 101 has a rectangular plane and is supported by twelve

pile foundations 4 arranged in three horizontal rows and four vertical columns; a plane of the circle of anti-collision platform 102 is a non-regular octagon that is narrow in a vertical direction and wide in a horizontal direction, the anti-collision platform 102 is supported by thirty-six pile foundations 4, and the pile foundations 4 are cast-in-place piles (as shown in FIG. 1a, FIG. 1b, and FIG. 1c).

[0056] The construction process of the present invention uses a cofferdam of a steel-concrete structure for construction, and the cofferdam consists of a cofferdam bottom plate prefabricated by means of reinforced concrete and a steel side formwork.

[0057] The construction process of the present invention comprises the following stages: a preparation stage, a cofferdam mounting stage, a cofferdam lowering stage, a cofferdam bottom plate blocking and water pumping stage, and a platform concrete pouring stage;

[0058] the preparation stage comprises the following steps: pile foundation casing sinking, cast-in-place pile construction, pile foundation casing pile head trimming, cofferdam bottom plate 1 and skirt plate prefabrication, and steel side formwork 2 manufacturing;

[0059] the cofferdam bottom plate 1 is divided into a plurality of rectangular prefabricated slabs 10, with each prefabricated slab 10 covering 1 to 2 pile foundations 4 (as shown in FIG. 2a and FIG. 2b); C-type wet joints 1A are arranged between the prefabricated slabs 10, and overlapping reinforcing bars are reserved; primary stepped pile holes 1B with a large top and small bottom are reserved on each prefabricated slab 10 based on positions of the pile foundations 4; a radius of a lower part of each pile hole 1B is 75 mm greater than that of each pile foundation casing 4A; and a hanging rod is pre-embedded at each of four corners of each prefabricated slab 10;

[0060] implementation of the cofferdam bottom plate and skirt plate prefabrication step comprises the following procedures:

[0061] 1) setting up a profile steel staging as a prefabricated bottom formwork for the prefabricated slabs;

[0062] 2) setting out positions of the pile holes in the prefabricated bottom formwork based on center coordinates of a pile foundation, and adjusting an elevation properly;

[0063] 3) binding the reinforcing bars inside the prefabricated slabs on the prefabricated bottom formwork, and mounting various pre-embedded parts properly, where the pre-embedded parts comprise four hanging rods that are arranged at the four corners of each prefabricated slab in a one-to-one correspondence manner;

[0064] 4) when prefabricating the prefabricated slabs located at the edge of the

cofferdam bottom plate, mounting a skirt plate side formwork on the prefabricated bottom formwork, and fastening a split bolt between the skirt plate side formwork and the prefabricated bottom formwork properly; and

[0065] 5) pouring concrete, and removing the skirt plate side formwork and the prefabricated bottom formwork after 24 hours;

[0066] where after the prefabrication of the prefabricated slabs 10 is completed, an angle steel bracket 3 for supporting the steel side formwork is mounted on an outer side surface of each prefabricated slab 10 located at an edge of the cofferdam bottom plate 1 using pre-embedded bolts 30; and a distance from a top surface of the angle steel bracket 3 to a top surface of the prefabricated slab 10 is 20 cm;

[0067] the steel side formwork 2 is of a wall-wrapping-bottom structure, that is, the bottom of the steel side formwork 2 overlaps with the outer side surface of the cofferdam bottom plate 1 by 20 cm; the steel side formwork 2 is composed of a plurality of side mold plates spliced together, and each side mold plate has a height of 5.2 m and a length of 3 m; a bottom of each side mold plate is supported on the angle steel bracket 3, and each side mold plate is supported by a diagonal bracing 20, of which a lower end is fixed on the cofferdam bottom plate 1, to be in a vertical state; and the diagonal bracing 20 has a support height of 4 m (as shown in FIG. 2c and FIG. 2d);

[0068] the cofferdam mountingstage comprisesfirst, mounting the cofferdam bottom plate 1, and then mounting the steel side formwork 2, where the cofferdam bottom plate 1 is mountedby means of suspension hangers, and each suspension hanger comprises a pile cap 40, an inverted hanging beam 41, and two first finish-rolled twisted steel bars 42; the pile caps 40 aremounted at tops of pile foundation casings 4A; the inverted hanging beam 41 is arranged directly above each pile hole 1B in a prefabricated bottom plate 10; lower ends of the two first finish-rolled twisted steel bars 42 are pre-embedded onto the prefabricated slab 10 and are located centrosymmetrically on an outer side of each pile hole 1B, and upper parts of the two first finish-rolled twisted steel bars 42 are each anchored at both ends of the inverted hanging beam 41 through gaskets and sleeves in a one-to-one correspondence manner (as shown in FIG. 3);

[0069] mounting of the cofferdam bottom plate comprises the following steps:

[0070] step 1, first mounting a floatable gap blocking bottom formwork between the pile holes 1B of the cofferdam bottom plate 1 and the pile foundation casings 4A on the pile foundation casings 4A, where the gap blocking bottom formwork is composed of an annular wood mold plate 61, an annular foam bottom plate 62, and a rubber washer 63

that are superposed from bottom to top; and then mounting the pile caps 40 at top ends of the pile foundation casings 4A;

[0071] step 2, first connecting a crane of a crane ship to a rectangular frame-type hanger, then connecting the hanger to four hanging rods on the prefabricated slabs 10, then using the crane of the crane ship to hang the prefabricated slabs 10 to a position above a corresponding pile foundation casing 4A and sleeve the pile holes 1B in the prefabricated slabs 10 onto the corresponding pile foundation casing 4A, observing elevations and horizontal positions of the prefabricated slabs 10, adjusting positions of the gaskets and the sleeves on the first finish-rolled twisted steel bars 42 based on observation results, adjusting an elevation deviation of the prefabricated slabs 10 to ≤ 5 mm, and then using jacks arranged radially on the step surfaces of the pile holes 1B to adjust a plane position deviation of the prefabricated slabs 10 to ≤ 10 mm; and then, lowering the prefabricated slabs 10 until the inverted hanging beam 41 on the prefabricated slabs 10 rests on the corresponding pile cap 40, then welding and fixing the inverted hanging beam 41 with the pile cap 40, and finally, enabling the hanger to be separated from the hanging rods, and supporting the prefabricated slabs 10 by the suspension hangers to ensure that the prefabricated slabs 10 are located above a water surface; where at this time, the gravity of the prefabricated slabs 10 is transferred to the pile foundation casings 4A through the first finish-rolled twisted steel bars 42, the inverted hanging beam 41, and the pile cap 40;

[0072] step 3, mounting the remaining prefabricated slabs one by one in accordance with step 2 until the mounting of the entire cofferdam bottom plate is completed, where at this time, the suspension hangers on each prefabricated bottom plate form a suspension hanger system;

[0073] step 4, first welding the overlapping reinforcing bars of the wet joints 1A between each prefabricated slab 10, and then pouring concrete into the wet joints 1A to form a complete cofferdam bottom plate 1;

[0074] mounting of the steel side formwork involves: first mounting two layers of water-stopping expansion rubber plates 31 on a top surface of the angle steel bracket 3 located on an outer side surface of the cofferdam bottom plate 1, then mounting the side mold plates one by one on the top surface of the angle steel bracket 3, where adjacent side mold plates are spliced using two columns of bolts, and a water-stopping rubber strip is arranged between and on both sides of the two columns of the bolts on a spliced surface, respectively; the steel side formwork 2 is connected to the angle steel bracket 3 through a plurality of vertical pull rods 2A that are arranged at intervals of 1.5 m, so as to restrict

the horizontal movement of the cofferdam bottom plate 1; a layer of water-stopping expansion rubber plate 31 is arranged between an inner side surface of a lower part of the steel side formwork 2 and a lower part of the spliced surface of the cofferdam bottom plate 1, and a gap between the inner side surface of the lower part of the steel side formwork 2 and an upper part of the spliced surface of the cofferdam bottom plate 1 is filled with structural adhesive 32; and then, the lower end of the diagonal bracing 20 of each side mold plate is fastened onto the cofferdam bottom plate 1 (as shown in FIG. 2c and FIG. 2d);

[0075] the cofferdam lowering stage comprises the following steps:

[0076] step 1, mounting a jack lowering system on the cofferdam bottom plate 1, where the jack lowering system comprises I-shaped hangers 50, carrying pole beams 52, center hole jacks 53, and steel strands 54; the I-shaped hangers 50 are fixed onto the cofferdam bottom plate 1 through four second finish-rolled twisted steel bars 51 that are pre-embedded onto the cofferdam bottom plate 1 and are located between two inverted hanging beams 41; the carrying pole beams 52 are erected between middle parts of top surfaces of the two inverted hanging beams 41; the center hole jacks 53 are arranged at middle parts of top surfaces of the carrying pole beams 52; and lower ends of the steel strands 54 sequentially pass through perforations of the center hole jacks 53 and the carrying pole beams 52 and are then anchored at middle parts of waists of the I-shaped hangers 50 (as shown in FIG. 4 and FIG. 5);

[0077] step 2, first symmetrically mounting two back bracing rods 6 with a length of 4 m on an outer side of the pile foundation casing 4A, where bottoms of the back bracing rods 6 are fixed onto the cofferdam bottom plate 1 through bolts, and upper ends of the back bracing rods 6 are free; and

[0078] step 3, first loosening sleeves anchoring the first finish-rolled twisted steel bars 42 on each suspension hanger to the inverted hanging beams 41, and then using a plurality of center hole jacks 53 in the jack lowering system to lift the cofferdam upwards by 20 cm in a step-by-step manner to ensure that the cofferdam is switched from being supported by the suspension hanger system to being supported by the jack lowering system; and then hanging the cofferdam downwards into water, enabling the gravity of the cofferdam to be transferred to the pile foundation casings 4A through the cofferdam bottom plate 1, the second finish-rolled twisted steel bars 51, the I-shaped hangers 50, the steel strands 54, the center hole jacks 53, the carrying pole beams 52, the inverted hanging beams 41, and the pile cap 40, until a top elevation of the cofferdam bottom plate 1

reaches a designed bottom elevation of the platform, where the gap blocking bottom formwork on each pile foundation casing 4A is pressed into the water as the cofferdam is lowered;

[0079] the cofferdam bottom plate blocking and water pumping stage comprises the following steps:

[0080] step 1, after the cofferdam is lowered into place, a top elevation of each back bracing rod 6 being also lower than a top elevation of each pile foundation casing 4A; first welding and fixing tops of the back bracing rods 6 onto outer surfaces of the pile foundation casings 4A, and then refastening the sleeves anchoring the first finish-rolled twisted steel bars 42 on each suspension hanger to the inverted hanging beams 41 to ensure that the gravity of the cofferdam is borne by the suspension hangers again and buoyancy of the cofferdam is resisted by the back bracing rods 6, thus forming a pull-and-support system (as shown in FIG. 6); and then removing the jack lowering system;

[0081] step 2, during low tide, lifting a gap blocking bottom formwork pre-sleeved on each pile foundation casing 4A upwards until a top surface of the annular foam bottom plate is tightly fitted with a bottom surface of the cofferdam bottom plate 1; enabling the rubber washer 63 to enter a spacing between each pile hole 1B and each pile foundation casing 4A; and then pouring a mixed mortar 60 containing epoxy resin between the gap blocking bottom formwork and the cofferdam bottom plate 1, and solidifying for 1 hour so as to complete spacing blocking between each pile foundation casing 4A and corresponding pile holes 1B in the cofferdam bottom plate 1;

[0082] step 3, pumping out all water in the cofferdam to form dry work construction conditions;

[0083] the platform concrete pouring stage comprises the following steps:

[0084] step 1, welding 7 to 8 shear keys 7 along a circumference in a uniformly distributed manner on a peripheral surface of each pile foundation casing 4A, where an inner side end of each shear key 7 is welded and fixed onto the outer surface of each pile foundation casing 4A, and a lower end of each shear key 7 is bolted and fixed onto step surfaces of the pile holes 1B of the cofferdam bottom plate 1 (as shown in FIG. 7);

[0085] step 2, first removing the back bracing rods 6 and the suspension hangers to convert the weight of the entire cofferdam to be supported by the shear keys 7; then, removing the pile cap 40 and cutting the pile foundation casings 4A to a designed top elevation, followed by using a rock splitting bar to drill 6-8 holes radially along a pile head at a height of 300 mm above a designed elevation of a pile top, with depths of the

holes being 40-50 cm; and inserting a hydraulic flange separator into the drilled holes to separate concrete pile heads, and then hanging and removing detached concrete pile heads as a whole, and using a pneumatic pick to manually chisel off remaining concrete with a height of 300 mm on an upper part of the pile top;

[0086] step 3, first arranging a wood internal formwork between the main platform and the anti-collision platform, and then cutting the cofferdam bottom plate using a wire saw method to ensure that the main platform is separated from the anti-collision platform; then, binding reinforcing bars layer by layer in the cofferdam, and pouring the concrete in three layers, where a first layer of concrete has a pouring height of 1 m, a second layer of concrete has a pouring height of 2 m, and a third layer of concrete has a pouring height of 3 m; and when the first layer of concrete and the second layer of concrete is poured, the diagonal bracing 20 of each side mold plate 2 is poured in the concrete; after the second layer of concrete is completely poured, first mounting an opposite-pull screw 2B on the side mold plate 2 above the second layer of concrete, i.e., at a height of 4.7 m, then cutting off the diagonal bracing 20 of which a height is above a top surface of the second layer of concrete, and then pouring the third layer of concrete (as shown in FIG. 8);

[0087] step 4, removing the steel side formwork.

[0088] The above embodiments are merely for the purpose of illustrating the present invention, rather than limiting the present invention. Those skilled in the art can also make various changes or modifications without departing from the spirit and scope of the present invention. Therefore, all equivalent technical solutions should also fall within the scope of the present invention and be defined by the claims.

CLAIMS

What is claimed is:

Claim 1: A construction process of an offshore bridge high-rise pile platform, wherein the platform comprises a main platform and a circle of anti-collision platform arranged on an outer side of the main platform, a spacing between the main platform and the anti-collision platform is A, and a circle of skirt plate extending into a bottom of the anti-collision platform by B is arranged on an outer side of the anti-collision platform; the main platform has a rectangular plane and is supported by twelve pile foundations arranged in three horizontal rows and four vertical columns; a plane of the circle of anti-collision platform is a non-regular octagon that is narrow in a vertical direction and wide in a horizontal direction, the anti-collision platform is supported by thirty-six pile foundations, and the pile foundations are cast-in-place piles; the construction process uses a cofferdam of a steel-concrete structure for construction, and the cofferdam consists of a cofferdam bottom plate prefabricated by means of reinforced concrete and a steel side formwork; and the construction process comprises the following stages: a preparation stage, a cofferdam mounting stage, a cofferdam lowering stage, a cofferdam bottom plate blocking and water pumping stage, and a platform concrete pouring stage, wherein

the preparation stage comprises the following steps: pile foundation casing sinking, cast-in-place pile construction, pile foundation casing pile head trimming, cofferdam bottom plate and skirt plate prefabrication, and steel side formwork manufacturing;

during implementation of the cofferdam bottom plate and skirt plate prefabrication step, the cofferdam bottom plate is divided into a plurality of rectangular prefabricated slabs, with each prefabricated slab covering 1 to 2 pile foundations; C-type wet joints are arranged between the prefabricated slabs, and overlapping reinforcing bars are reserved; primary stepped pile holes with a large top and small bottom are reserved on each prefabricated slab based on positions of the pile foundations; during prefabrication, a hanging rod is pre-embedded at each of four corners of each prefabricated

slab; and after the prefabrication of the prefabricated slabs is completed, an angle steel bracket for supporting the steel side formwork is mounted on an outer side surface of each prefabricated slab located at an edge of the cofferdam bottom plate using pre-embedded bolts;

the steel side formwork is composed of a plurality of side mold plates spliced together; a bottom of each side mold plate is supported on the angle steel bracket, and each side mold plate is supported by a diagonal bracing, of which a lower end is fixed on the cofferdam bottom plate, to be in a vertical state;

the cofferdam mounting stage comprises first, mounting the cofferdam bottom plate, and then mounting the steel side formwork, wherein the cofferdam bottom plate is mounted by means of suspension hangers, and each suspension hanger comprises a pile cap, an inverted hanging beam, and two first finish-rolled twisted steel bars; the pile caps are mounted at tops of pile foundation casings; the inverted hanging beam is arranged directly above the pile holes in a prefabricated bottom plate; lower ends of the two first finish-rolled twisted steel bars are pre-embedded onto the prefabricated slab and are located centrosymmetrically on an outer side of each pile hole, and upper parts of the two first finish-rolled twisted steel bars are each anchored at both ends of the inverted hanging beam through gaskets and sleeves in a one-to-one correspondence manner;

mounting of the cofferdam bottom plate comprises the following steps:

step 1, first mounting a floatable gap blocking bottom formwork between the pile holes of the cofferdam bottom plate and the pile foundation casings on the pile foundation casings, and then mounting the pile caps at top ends of the pile foundation casings;

step 2, first connecting a crane of a crane ship to a rectangular frame-type hanger, then connecting the hanger to four hanging rods on the prefabricated slabs, then using the crane of the crane ship to hang the prefabricated slabs to a position above a corresponding pile foundation casing and sleeve the pile holes in the prefabricated slabs onto the corresponding pile foundation casing; and then, lowering the prefabricated slabs until the inverted hanging beam on the prefabricated slabs rests on the

corresponding pile cap, then welding and fixing the inverted hanging beam with the pile cap, and finally, enabling the hanger to be separated from the hanging rods, and supporting the prefabricated slabs by the suspension hangers to ensure that the prefabricated slabs are located above a water surface;

step 3, mounting the remaining prefabricated slabs one by one in accordance with step 2 until the mounting of the entire cofferdam bottom plate is completed; and

step 4, first welding the overlapping reinforcing bars of the wet joints between each prefabricated slab, and then pouring concrete into the wet joints to form a complete cofferdam bottom plate;

mounting of the steel side formwork involves: first mounting two layers of water-stopping expansion rubber plates on a top surface of the angle steel bracket located on an outer side surface of the cofferdam bottom plate, then mounting the side mold plates one by one on the top surface of the angle steel bracket, wherein adjacent side mold plates are spliced using two columns of bolts, and a water-stopping rubber strip is arranged between and on both sides of the two columns of the bolts on a spliced surface, respectively; the steel side formwork is connected to the angle steel bracket through a plurality of vertical pull rods that are arranged at intervals, a layer of water-stopping expansion rubber plate is arranged between an inner side surface of a lower part of the steel side formwork and a lower part of the spliced surface of the cofferdam bottom plate, and a gap between the inner side surface of the lower part of the steel side formwork and an upper part of the spliced surface of the cofferdam bottom plate is filled with structural adhesive; and then, the lower end of the diagonal bracing of each side mold plate is fastened onto the cofferdam bottom plate;

the cofferdam lowering stage comprises the following steps:

step 1, mounting a jack lowering system on the cofferdam bottom plate, wherein the jack lowering system comprises I-shaped hangers, carrying pole beams, center hole jacks, and steel strands; the I-shaped hangers are fixed onto the cofferdam bottom plate through four second finish-rolled twisted steel bars that are pre-embedded onto the cofferdam bottom plate and are

located between two inverted hanging beams; the carrying pole beams are erected between middle parts of top surfaces of the two inverted hanging beams; the center hole jacks are arranged at middle parts of top surfaces of the carrying pole beams; and lower ends of the steel strands sequentially pass through the center hole jacks and the carrying pole beams and are then anchored at middle parts of waists of the I-shaped hangers;

step 2, first mounting two back bracing rods on an outer side of each pile foundation casing, wherein bottoms of the back bracing rods are fixed onto the cofferdam bottom plate through bolts, and upper ends of the back bracing rods are free; and

step 3, first loosening sleeves anchoring the first finish-rolled twisted steel bars on each suspension hanger to the inverted hanging beams, and then using a plurality of center hole jacks in the jack lowering system to hang the entire cofferdam downwards into water in a step-by-step manner until a top elevation of the cofferdam bottom plate reaches a designed bottom elevation of the platform;

the cofferdam bottom plate blocking and water pumping stage comprises the following steps:

step 1, after the cofferdam is lowered into place, a top elevation of each back bracing rod being also lower than a top elevation of each pile foundation casing; first welding and fixing tops of the back bracing rods onto outer surfaces of the pile foundation casings, and then refastening the sleeves anchoring the first finish-rolled twisted steel bars on each suspension hanger to the inverted hanging beams to ensure that gravity of the cofferdam is borne by the suspension hangers again and buoyancy of the cofferdam is resisted by the back bracing rods, and then removing the jack lowering system;

step 2, during low tide, lifting a gap blocking bottom formwork pre-sleeved on the pile foundation casing upwards to tightly fit with the cofferdam bottom plate, then pouring a mixed mortar containing epoxy resin between the gap blocking bottom formwork and the cofferdam bottom plate, and solidifying for 1 hour so as to complete spacing blocking between each pile foundation casing and corresponding pile holes in the cofferdam bottom

plate; and

step 3, pumping out all water in the cofferdam to form dry work construction conditions;

the platform concrete pouring stage comprises the following steps:

step 1, welding a plurality of shear keys along a circumference in a uniformly distributed manner on a peripheral surface of each pile foundation casing, wherein inner side ends of the plurality of shear keys are welded and fixed onto the outer surface of each pile foundation casing, and lower ends of the plurality of shear keys are bolted and fixed onto step surfaces of the pile holes of the cofferdam bottom plate;

step 2, first removing the back bracing rods and the suspension hangers to ensure that the entire cofferdam is supported by the shear keys; then, cutting the pile foundation casings to a designed top elevation, followed by using a rock splitting bar to drill 6-8 insertion holes radially along a pile head at a height of 300 mm above a designed elevation of a pile top, with depths of the insertion holes being 40-50 cm; and inserting a hydraulic flange separator into the insertion holes to separate concrete pile heads, and then hanging and removing detached concrete pile heads as a whole, and using a pneumatic pick to manually chisel off remaining concrete with a height of 300 mm on an upper part of the pile top;

step 3, first arranging a wood internal formwork between the main platform and the anti-collision platform to separate the main platform from the anti-collision platform, followed by binding reinforcing bars layer by layer in the cofferdam, and then pouring the concrete in three layers, wherein when a first layer of concrete and a second layer of concrete is poured, the diagonal bracing of each side mold plate is poured in the concrete; after the second layer of concrete is completely poured, first mounting an opposite-pull screw on the side mold plate above the second layer of concrete, then cutting off the diagonal bracing of which a height is above a top surface of the second layer of concrete, and then pouring a third layer of concrete; and when the third layer of concrete is poured, controlling verticality of the side mold plate using the opposite-pull screw; and

step 4, first removing the steel side formwork, and then cutting the

cofferdam bottom plate using a wire saw method to ensure that the cofferdam bottom plate is separated from the main platform and the anti-collision platform.

Claim 2: The construction process of an offshore bridge high-rise pile platform according to claim 1, wherein implementation of the cofferdam bottom plate and skirt plate prefabrication step comprises the following procedures:

1) setting up a profile steel staging as a prefabricated bottom formwork for the prefabricated slabs;

2) setting out positions of the pile holes in the prefabricated bottom formwork based on center coordinates of a pile foundation, and adjusting an elevation properly;

3) binding the reinforcing bars inside the prefabricated slabs on the prefabricated bottom formwork, and mounting various pre-embedded parts properly, wherein the pre-embedded parts comprise four hanging rods that are arranged at the four corners of each prefabricated slab in a one-to-one correspondence manner;

4) when prefabricating the prefabricated slabs located at the edge of the cofferdam bottom plate, mounting a skirt plate side formwork on the prefabricated bottom formwork, and fastening a split bolt between the skirt plate side formwork and the prefabricated bottom formwork properly; and

5) pouring concrete, and removing the skirt plate side formwork and the prefabricated bottom formwork after 24 hours.

Claim 3: The construction process of an offshore bridge high-rise pile platform according to claim 1, wherein the gap blocking bottom formwork is composed of an annular wood mold plate, an annular foam bottom plate, and a rubber washer that are superposed from bottom to top.

Claim 4: The construction process of an offshore bridge high-rise pile platform according to claim 1, wherein implementation of step 2 of the cofferdam mounting stage further involves: observing elevations and horizontal positions of the prefabricated slabs, adjusting positions of the gaskets and the sleeves on the first finish-rolled twisted steel bars based on observation

results, adjusting an elevation deviation of the prefabricated slabs to ≤ 5 mm, and then using jacks arranged radially on the step surfaces of the pile holes to adjust a plane position deviation of the prefabricated bottom plate to ≤ 10 mm.