METHOD OF BUILDING CONCRETE STRUCTURES IN WATER BOTTOMS
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ABSTRACT OF THE DISCLOSURE

A method of building a concrete structure in one place and sitting it at another place in water wherein at least a building of the structure is constructed in a floating dock which is partially submerged and stably grounded on a water bed in shallow water by filling water into the dock so that the construction will be carried out under the same favorable stable conditions as would exist were the construction to be performed on land. The partially submerged dock is then refloated by pumping out the water and towed to deep water where it is again submerged by filling in water so that the dock sinks below and separates from the complete or incomplete concrete structure which remains floating. The latter is then sunk at the intended site by filling in water, and the dock is then refloated by pumping out the water and towed back to the original shallow water location for reuse.

This invention relates to improvements of a method of building breakwaters and other concrete structures in water bottoms.

There has been already suggested a method of building breakwaters and other similar structures in water bottoms wherein a hollow concrete structure is built on the land, is moved onto the water along a slipway of a length reaching to the water from the land in the same manner as if a ship were launched, is floated on the surface of the water by its own buoyancy, is then towed to a destination and is sunk there down to the bottom with water introduced into it. According to another known method, a hollow concrete structure is built in a large dock formed on the shore, is floated on the surface of water by its own buoyancy by introducing water into the dock, is towed to a destination by opening the gate of the dock and is sunk there down to the bottom by its own weight by being filled with water. However, in such method, a high equipment cost will be required to form the above mentioned slipway or dock, the time for the construction will be long and will be influenced by the weather and the safety in the operation will be difficult.

The present invention is suggested to eliminate such defects as are mentioned above.

An object of the present invention is to provide a method of building concrete structures in water bottoms wherein the equipment cost can be saved, the time for the construction can be reduced and the safety in the operation of the equipment and the building of the structure is high.

Summary of the invention

In accordance with the improved method provided by the present invention, a floatable dock is partially submerged and stably grounded on a water bed in shallow water by filling water into the dock, and at least the base part of the concrete structure is then constructed on this stable support. The partially submerged dock is then refloated by pumping out the water and towed to deeper water where it is again submerged by filling in water so that the dock sinks below and separates from the complete or incomplete concrete structure which remains floating. If incomplete at this stage, the floating concrete structure is then completed to its final form, and is then sunk at the intended site. The dock is then refloated by pumping out the water and is towed back to the original shallow water location for re-use. If only the base part of the concrete structure is constructed when the dock is stably grounded in shallow water and is not self-floating, the concrete structure is either fully completed or at least partially completed to render it self-floating after the dock is refloated and towed to deeper water.

An embodiment of the present invention shall be explained in the following with reference to the drawings in which:

FIG. 1 is a partially sectioned view of a simple floating dock to be used in the method of the present invention and a concrete structure built in said floating dock;

FIG. 2 is a vertically sectioned view of the same; and

FIGS. 3(A) to (G) are sketches showing the steps of the method of the present invention.

In FIGS. 1 and 2, a is a simple floating dock to be used in the method of the present invention. Said floating dock d is made by fixing a watertight bottom plate 2 made of a steel plate to the bottom surface of a square surrounding hollow float 1 made of steel plates, providing stands 3 for making concrete structures on said bottom plate 2 to form a working place 4 for making such concrete structure b and further providing a water inlet and outlet valve 5 in each of the four corners on the upper surface of the above mentioned surrounding hollow float 1.

In working the method of the present invention, as shown in (A) in FIG. 3, the floating dock a illustrated in FIGS. 1 and 2 is floated on the surface of water in a comparatively shallow place d selected or artificially made near the shore of a sea, river or lake, is then partially submerged in the shallow water to such degree that its upper end edge is not immersed in water by pouring water e into the working place 4 and is thus fixed in a stable state on the water bottom ground f in said shallow place d. Then, a concrete pouring operation for the concrete structure b1, which is, for example, to be the lowest part of a breakwater is carried out in said working place 4. The floating dock a is in such stable state in contact with the water bottom ground that said concrete pouring operation can be carried out in the same stable state as on the land and therefore there will be no fear of cracking at all in the concrete structure b1 when it is cured and set. After the concrete structure b1 is built in this manner, said floating dock a is re-floated to a level above the ground by discharging water e in the working place 4 in the floating dock a as shown in (B) in FIG. 3 and is then quietly towed together with the concrete structure b1 to a comparatively deep place d′ and is fixed there with a proper anchor g so as not to be moved or made unstable by wind and waves as shown in (C) in FIG. 3. Then another concrete structure b2 is added and joined on the concrete structure b1 to form a combined concrete structure b2. It is needless to say that such addition should be made by so considering in advance that the floating dock a may not be sunk under the weight of the concrete structures b1 and b2.

After the thus added and joined concrete structure b2 has been completely cured and set, as shown in (D) in FIG. 3, water e′ is put into the entire working place 4 in the floating dock a and then some water e″ (of a weight larger than the weight of the floating dock) is put into the surrounding float 1 of the floating dock a by opening the water inlet and outlet valves 5 of the float 1 all at once so that the floating dock a may be sunk in water and the
above mentioned combined concrete structure $b_2$ may be perfectly separated from the floating dock $a$. After lateral separation as between the now floating concrete structure $b_3$ and the submerged dock, the water $e'$ in the surrounding float 1 of the submerged dock $a$ is discharged through the water inlet and outlet valves 5 so that the floating dock $a$ may again rise up to the surface of the water. Then, the water $e'$ in the working place 4 of the floating dock $a$ is discharged so that the floating dock $a$ may be perfectly floated on the water surface as shown in (E) in FIG. 3. Thus the floating dock $a$ is then returned to the position in (A) in the drawing and is prepared for the sound building of the concrete structure. At the same time, a further concrete structure $b_4$ is added and jointed on the concrete structure $b_2$ floating along on the water surface as shown in (F) in FIG. 3. When the entire height of the combined concrete structure $b_3$ thus formed has become a fixed height as shown in (G) in the drawing, water is poured into said structure $b_2$ so that the structure may sink down to the water bottom ground. By repeating such steps as are described above, many concrete structures $b_2$ are made and are sunk and arranged on the water bottom ground to build such concrete structure as a breakwater.

In the method of the present invention, as the partially submerged dock $a$ will be in a stable state perfectly in contact with the water bottom ground $f$ when concrete is poured in to form the concrete structure $b_1$ which is to be the lowest part of a structure to be built as explained above, there will be no fear at all of cracking in the concrete structure $b_1$ formed on the floating dock when it is cured and set. (If concrete is poured in to form the concrete structure $b_1$ in the dock $a$ as floated on the water surface, the floating dock $a$ will be so unstable that the concrete structure will be likely to crack within when it is cured and set.) Further, in the method of the present invention, it is not necessary to construct such large slipway or dock as in a conventional method of this kind and therefore the equipment cost and maintenance cost can be greatly reduced and the time for the construction can be remarkably reduced to be less than in the conventional method. Further, the method of the present invention is not only higher in the safety of the operation but also can be carried out more easily without being influenced by the weather than in a method wherein a concrete structure is completed to be of a fixed size, is then towed to a sitting place and is installed there.

What is claimed is:

1. The method of building a concrete structure at one location and sitting it at another location in water which comprises the steps of:
   (a) stable grounding an initially floating dock on a water bed in shallow water by filling water into the dock, the depth of the bed below the surface of the water being less than the height of the dock,
   (b) constructing at least a base part of the concrete structure within the partially submerged and grounded dock,
   (c) discharging the water from inside the dock to re-float the dock and the concrete structure,
   (d) towing said re-floated dock and the concrete structure to deeper water,
   (e) sinking the re-floated dock in said deeper water by again filling water into the dock thereby to separate it from the concrete structure which remains floating,
   (f) sinking the floating concrete structure at its final resting place on the bottom at said site and
   (g) re-floating the dock by discharging the water from inside the dock thereby enabling said dock to be towed back to said shallow water bed for re-use.

2. The method as defined in claim 1 wherein the base part of said concrete structure is constructed while said dock is stably grounded, and which includes the further step of adding at least one further portion to the base part after said dock has been towed to deeper water.

3. The method as defined in claim 2 wherein the base part of said concrete structure is by itself incapable of floating and the addition of said further portion renders the structure capable of floating by its own buoyancy.

4. The method as defined in claim 1 of building a concrete structure and sitting it in water wherein only a lower portion of said concrete structure is constructed while said dock is stably grounded, and which includes the further step of adding at least one further portion to the lower portion after said dock has been sunk in the deeper water but before the concrete structure is sunk.

5. The method as defined in claim 1 of building a concrete structure and sitting it in water wherein said floating dock comprises peripherally extending double walls establishing therebetween a peripheral float chamber, a water inlet and outlet valve means for introducing water into said float chamber and thereafter discharging it, and a plate-like bottom secured in a water-tight manner to said peripheral float chamber structure.

6. The method as defined in claim 5 wherein said initially floating dock is stably grounded by filling water into the plate-like bottom of the dock.

7. The method as defined in claim 5 wherein the step of sinking the re-floated dock in said deeper water to separate it from the concrete structure which remains floating is accomplished by initially filling water into the dock within the confines established by said peripheral float chamber until said concrete structure floats by virtue of its own buoyancy, and thereafter filling water into said peripheral float chamber to further sink said dock to a depth sufficient to clear the underside of said concrete structure.

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