

DEVICE AND METHOD FOR LOWERING A PROTECTIVE SLAB ON A BOTTOM OF A WATER BASIN

FIELD OF THE INVENTION

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The present invention relates to a device for lowering a protective slab on a bottom of a water basin. A number of such slabs positioned adjacent to each other may form an effective scour protection for the bottom, such as may be needed in harbors, for instance extending alongside a quay wall. The invention further relates to a method for lowering
10 a protective slab on a bottom of a water basin and providing scour protection.

BACKGROUND OF THE INVENTION

Marine transport is ever increasing, both in quantity and size. Vessels are becoming
15 larger and larger to be able to carry more load. The increasing size of vessels has an impact on harbor infrastructure, as docking basins need to be made deeper and quay walls stronger. The larger and more powerful propulsion carried by the larger vessels may cause damage to water basis bottoms and quay walls, which necessitates stronger scour protection.

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State of the art scour protection is typically provided by pouring granular protection onto the bottom, optionally strengthened with liquid asphalt mastic, or by lowering protective mattresses of concrete blocks, rock or fibrous stone asphalt onto the bottom. Another possibility is to lower protective slabs of reinforced concrete onto the bottom.
25 A number of these slabs positioned side by side to each other may form an effective scour protection for the bottom. However, accurate positioning of the slabs is important since ill-placed slabs tend to shift in time and may even be lifted by seepage water. Accurate positioning is even more difficult for relatively deep water bottoms.

30 It is an aim of the present invention to provide a device and method for accurately lowering a protective slab onto a bottom of a water basin and thereby providing an effective scour protection in an efficient way. It is another aim of the invention to provide a device for lowering a protective slab onto a bottom of a water basin that can

easily be adapted to changing circumstances, such as a desired size of the slab for instance.

BRIEF SUMMARY OF THE INVENTION

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The above and other aims are provided by a device in accordance with claim 1. The device aims at lowering a protective slab on a bottom of a water basin, and comprises a lifting frame that can be suspended from a crane and lowered under water, and to which a slab can be releasably connected, the lifting frame further comprising monitoring
10 equipment for establishing a position of the slab; and, associated with the lifting frame, a floating frame that can be suspended from the crane together with the lifting frame and lowered onto the water surface, the floating frame comprising buoyancy means and further auxiliary equipment for operating the monitoring equipment of the lifting frame.

15 In another aspect of the invention, an assembly of the invented device and a crane, provided on a support surface is provided.

In yet another aspect of the invention, a method for lowering a protective slab on a bottom of a water basin is provided, the method comprising providing the assembly of
20 the crane and device, connecting a protective slab to the lifting frame of the device; suspending the device from the crane; lowering the device provided with the slab to the bottom of the water basin, such that when reaching the water surface, the floating frame is released from the lifting frame and floats on the water surface, while the lifting frame lowers further; establishing the position of the submerged slab by means of the
25 monitoring equipment; and releasing the slab from the lifting frame when the slab is in the desired position on the bottom of the water basin.

The floating frame is instrumental in a number of ways, the prime advantage being that the load capacity of the lifting crane may be reduced when compared with known
30 methods and devices. Indeed, the floating frame itself has a relatively low weight and carries auxiliary equipment which needs not to be lowered together with the lifting frame.

The association of lifting frame and floating frame may be configured in a number of ways. A particularly advantageous embodiment relates to a device wherein the lifting frame comprises support means for supporting the floating frame during lifting by the crane. In this embodiment, the floating frame may effectively be supported on top of the lifting frame which, when lifted by the crane, automatically takes the floating frame with it.

Another embodiment of the invention relates to a device wherein the support means are configured to release the floating frame from the lifting frame when the floating frame reaches the water surface and finds itself in a floating position on the water surface. The lifting frame in this embodiment may be lowered further towards the bottom without the floating frame as it is suspended from the lifting crane.

The device and assembly of the invention allow an accurate positioning of a protective slab onto a bottom under water. The use of the floating frame already provides such accuracy. Another embodiment that is instrumental in obtaining a desired accuracy of positioning the slabs provides a device wherein the monitoring equipment of the lifting frame comprises underwater cameras. Such cameras can be used to provide guidance in maneuvering the slab while hanging in the crane and lifting frame. A particularly useful embodiment in this respect provides a device wherein the auxiliary equipment of the floating frame comprises water flushing means configured to carry clear water into a viewing volume of the monitoring equipment, preferably the cameras. Water flushing means may be configured as desired and in an embodiment comprise a water pump that connects with water hosing on a water hose reel. The water hosing extends from the water hose reel provided on the floating platform to a position in the vicinity of the monitoring means provided on the lifting platform. The water pump provides a flow of clear water through the hosing to the viewing volume of the monitoring means, such as the cameras, thereby clearing away or flushing turbid water that may hamper a clear view.

In another embodiment of the invention, the monitoring equipment of the lifting frame is positioned such that it covers corners of a slab connected to the lifting frame. This has proven to provide the best view, in particular when a relatively small gap size between adjacently positioned slabs on the bottom is desired.

In order to improve the positioning capabilities of the device, an embodiment provides a device wherein the monitoring equipment of the lifting frame further comprises motion sensors for monitoring a movement of the slab. A slab that is connected to the lifting
5 frame is subjected to movements of the lifting frame resulting from being suspended from the crane and positioned under water. Such movements may be induced by currents and the like, and may comprise pitch, roll and heading movements. Suitable motion sensors may comprise (fiber optic) gyroscopic accelerometers, but other systems may also be used.

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In order to further improve accuracy of placement, a particular embodiment of the invention provides a device wherein the monitoring equipment of the lifting frame further comprises narrow beam echo sounders for establishing a misalignment of the slab in a horizontal plane and/or a distance to a wall, such as a caisson wall, for instance
15 used as quay wall.

The device of the invention allows to position slabs onto a bottom under water with accurately defined gaps between them. A plurality of, preferably rectangular slabs, provides a scour protection to the bottom. The gap width between edges of adjacently
20 positioned slabs may be chosen according to the circumstances, for instance depending on the properties of a foundation layer for the slabs. A foundation layer may serve to support the concrete slabs, and distribute forces to the underlying soils. A suitable foundation layer may be horizontal but may also have a slope exhibiting an angle with the horizontal direction, whereby the angle may for instance be between 0-40 degrees,
25 between 0-30 degrees, or between 0-20 degrees. A foundation layer may conveniently be provided onto an existing bottom under by for instance dumping rocks or gravel, or any other suitable material, into the water from a vessel, for instance provided with a fall pipe, from a crane, or from any other suitable tool or device.

30 A particularly preferred embodiment of the invention provides a scour protection wherein the gap width ranges from 10-100 mm, more preferably from 20-90 mm, and most preferably from 30-80 mm. The preferred embodiments help preventing washing out of underwater bottom layers below the slabs, and add to the stability of the scour protection. The gaps between the concrete slabs should be present along one edge of

each of at least two slabs, preferably along two edges of each of at least three slabs, more preferably along three edges of each of at least four slabs, and most preferably along four edges of each of at least five slabs. The gaps may be present along edges that extend substantially parallel to an alongside direction of the quay wall, and/or may be present along edges that extend substantially perpendicular to the alongside direction of the quay wall. The gap width between slabs is preferably a constant but may vary along an edge of two adjacently positioned slabs, preferably within 50% of the average gap width, more preferably within 20% of the average gap width, and most preferably within 10% of the average gap width.

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A suitable scour protection is provided wherein the slabs have a thickness ranging from 200-500 mm, more preferably from 275-425 mm, and most preferably from 325-375 mm. These preferred thicknesses provide the required protection against erosion, and further allow handling the slabs while positioning them on an underwater bottom.

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To facilitate a correct positioning, an embodiment relates to slabs and a scour protection wherein edges of the slabs are provided with distance holders or spacing lugs. The spacing lugs may be separate or may be integral to the slab, and can be made from concrete, wood, rubber or another polymer, metal, and other suitable materials. The spacing lugs or distance holders are instrumental in maintaining the desired gap between slab edges.

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The device in accordance with the invention may be used to position slabs onto a bottom at any practical depth under water. In a preferred embodiment of the invention, at least some of the slabs are provided at a depth of at least 15 m, more preferably at least 20 m, and most preferably at least 25 m.

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The concrete slabs used with the device may have any shape and may be curved or flat. Preferably, the slabs are planar, and the edges of the slabs are straight and extend in a thickness direction perpendicular to the plane of the slabs. Suitable slabs have a lateral dimension of at least 5 m, more preferably of at least 6 m, and most preferably of at least 7 m, although other dimensions may also be used. In order to facilitate connection of one or more slabs to the lifting frame, the slabs may be provided with a number of holes that may extend from a front surface of the slabs to a back surface thereof. Holes

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may also be provided in the slabs in preventing uplifting forces that may destabilize the slabs when positioned in the bottom. The slabs may also comprise lifting brackets. The lifting brackets may be integrated into the concrete slabs during casting thereof, and may for instance comprise steel brackets.

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The concrete slabs to be used in the device and method of the invention may be prefabricated, preferably at or close to the site where a scour protection has to be provided. The slabs may comprise reinforcement bars (rebars), the number and properties of which are determined according to well known engineering principles. The rebars are instrumental in providing the slabs with the necessary strength when placed under water but also during lifting and positioning of the slabs onto the bottom.

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The monitoring equipment of the lifting frame and the auxiliary equipment of the floating frame may be powered in any possible way. A practical embodiment of the invention provides a device wherein the lifting frame comprises a water-tight electrical unit, powered by a power unit, such as a diesel generator, for operating the monitoring equipment. The electrical unit comprises the electronics configured to operate the monitoring equipment. Since it is part of the lifting frame that needs to submerge, it is provided water-tight.

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The above embodiment is preferably combined with an embodiment in which the auxiliary equipment of the floating frame comprises at least a generator for providing power, a switch board and an umbilical for connection with the lifting frame monitoring equipment. Apart from the power generator that provides all the equipment with the necessary power, the switchboard serves to connect the monitoring equipment of the lifting frame with other control and data storage equipment, provided on a vessel or other location. The data and control signals may be carried by a wireless connection between the switchboard and the control and data storage equipment.

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In order to further increase accuracy of placement, the device according to an embodiment of the invention comprising means for rotating the lifting frame in a horizontal plane when suspended from the crane. Suitable means comprise tugger lines associated with constant tension winches. These winches may be provided on a vessel, that optionally also carries the crane, but another location is also possible.

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Another embodiment may use a lifting frame further comprising a rotatable gripping beam for manipulating an assembly of protective beams and positioning this assembly on a slope of the water basin bottom. A suitable assembly comprises a plurality of
5 concrete beams that are arranged parallel to each other and interconnected by ropes extending between the beams.

Another aspect of the invention relates to an assembly of an embodiment of the invented device and a crane, provided on a support surface, such as the deck of a vessel
10 or pontoon. The crane is configured to be able to carry the combined load of a lifting frame and a floating frame, associated therewith. To be able to roughly estimate the position of a slab, connected to the lifting frame during suspension, the crane, preferably a boom of the crane, and more preferably a boom top of the crane, is provided with a global positioning system (GPS), known per se.

15 In yet another aspect of the invention, a floating frame, configured to be associated with the invented lifting frame is provided. A floating frame in accordance with this aspect of the invention is a stand-alone unit that may be combined with a lifting frame of any size and configuration. The floating frame provides the auxiliary equipment that is needed
20 for operating the monitoring equipment of the lifting frame, associated with it.

The embodiments of the invention as disclosed in the present application may be combined in any possible combination of these embodiments, and each embodiment separately may be the subject of a divisional application.

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BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be elucidated in more detail with reference to the accompanying figures, without otherwise being limited thereto. In the figures:

30 Figure 1 schematically shows a perspective view from above of a floating frame in accordance with an embodiment of the invention;
Figure 2 schematically shows a perspective view from above of a lifting frame in accordance with an embodiment of the invention;

Figure 3 schematically shows a perspective view from below of the floating frame in accordance with the embodiment shown in figure 1;

Figure 4 schematically shows a perspective view from below of the lifting frame in accordance with the embodiment shown in figure 2;

- 5 Figure 5 schematically shows a perspective view from above of a device that comprises the lifting frame in accordance with the embodiment shown in figure 2, and the floating frame in accordance with the embodiment shown in figure 1 in an unassembled position;

- Figure 6 schematically shows a perspective view from above of a device that comprises
10 the lifting frame in accordance with the embodiment shown in figure 2, and, associated therewith, the floating frame in accordance with the embodiment shown in figure 1;

Figures 7A to 7D schematically show some method steps in accordance an embodiment of the present invention; and

- Figures 8A and 8B finally show a perspective view of two method steps using an
15 embodiment of the device equipped with a rotatable gripping beam for manipulating an assembly of protective beams.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

- 20 With reference to figures 1 and 3, a floating frame 1 of a device in accordance with one embodiment of the invention is shown, while figures 2 and 4 show an embodiment of a lifting frame 2 of the device. As shown in figure 6, the floating frame 1 may be associated with the lifting frame 2 to form the device 3. Figure 5 shows the floating frame 1 and the lifting frame 2 in an aligned but unassociated position. The device is
25 used for lowering a protective slab 5 on a substrate such as a bottom 4 of a water basin.

- The embodiment of the lifting frame 2 shown in figures 2 and 4 comprises two longitudinal support girdles 20 and two transverse support girdles 21 that together form a frame (20, 21). The frame (20, 21) is provided with hoisting eyes 22 to which hoisting
30 wires 60 depending from a boom 61 of a crane 6 may be attached. The frame (20, 21) may be attached to the hoisting wires 60 and be suspended from the crane 6 to lower the lifting frame 2 under the water surface 7. The lifting frame 2 is configured to releasably connect a slab 5 to the frame (20, 21) by retractable hook devices 23 (see figure 4) provided on an underside of the lifting frame 2, whereby hook devices 23 cooperate

with brackets (not shown) provided on the slab 5. The lifting frame 2 further comprises support means in the form of poles 24 provided on the girdles 20 and extending in a vertical direction 8. The poles 24 are at an upper end thereof provided with V-shaped receiver beams 25 for receiving corresponding cylindrical feet 14 of the floating frame

5 1. A lower surface of the feet 24 is profiled such that it can engage the receiver beams 25.

The lifting frame 2 is further provided with monitoring equipment for establishing a position of the slab 5 relative to the bottom 4 under water. In the embodiment shown in

10 figures 2 and 4, the monitoring equipment of the lifting frame 2 comprises a number of underwater cameras 26 that are positioned on arms 27 extending outwardly of the frame (20, 21). The cameras 26 are positioned such that their angle of vision extends in a downward vertical direction 81 and moreover at least covers corners of the slab 5, when connected to the lifting frame 2.

15 In order to obtain a clear view under water, auxiliary equipment of the floating frame 1 comprises water flushing means configured to carry clear water into a viewing volume of the cameras 26. The water flushing means may for instance comprise a water pump 15a, provided in a housing 16 that connects to water hosing 15b, provided on water hose

20 reels 15c. The water hosing 15b exits in the vicinity of each water camera 26 when the floating frame 1 and the lifting frame 21 are in an engaged position.

The monitoring equipment of the lifting frame 2 may comprise other sensors such as motion sensors incorporated in an E-pod and Motion Reference Unit 28. This unit 28

25 comprises the electronics configured to operate all the monitoring equipment of the lifting frame 2. Since it is part of the lifting frame 2, that needs to submerge, it is provided water-tight. The motion sensors incorporated in unit 28 may comprise several types of motion sensor but a preferred motion sensor is configured to determine pitch, roll and heading motions of the lifting frame 2 and slab 5, such as accelerations, angular

30 rates, and velocity. A typical motion sensor comprises solid state 3 dimensional accelerometers, magnetometers, gyroscopes and barometric sensors to provide accurate motion measurements.

Further monitoring means provided on the lifting frame 2 may comprise a pair of narrow beam echo sounders 29 for establishing a misalignment of a slab 5 connected to the lifting frame 2 in a horizontal plane and/or a distance to a wall, such as a wall of caissons 30, as shown in figures 7A to 7D. The echo-sounders are provided on a sub-frame that is part of the lifting frame 2.

The lifting frame 2 may also be provided with a gripping beam 40 for manipulating an assembly of protective beams 50 and positioning the protective beams 50 on a slope of the water basin bottom 4, as shown in figures 8A and 8B. The gripping beam 40 is thereto provided with hydraulically operable grippers 41 at both ends of the beam 40. The gripping beam 40 may be rotated around a horizontal axis 82 by using hydraulic cylinders 42, provided between the beam 40 and the frame (20, 21)

With reference to figures 1 and 3, a floating frame 1 of a device in accordance with one embodiment of the invention is shown. The embodiment of the floating frame 1 shown comprises two longitudinal support girdles 10 and two transverse support girdles 11 that together form a frame (10, 11). At least some of the girdles (10, 11) may be hollow and the cavities provide the floating frame 1 with buoyancy. The feet 14 positioned at the corners of the frame (10, 11) may also be (partly) hollow, to provide additional buoyancy. If needed, additional buoyance means, for instance flexible bellows, may be provided on the floating frame 1.

The floating frame 1 further comprises auxiliary equipment for operating the monitoring equipment of the lifting frame 2. The auxiliary equipment of the floating frame 1 comprises at least a generator 17 (only the housing is shown) for providing power to the equipment of both lifting and floating frames. The floating frame 1 further carries a switchboard 18 and umbilicals 19a for connection with the lifting frame 2 equipment. The umbilicals 19a are provided on an umbilical reel 19b and extend along an umbilical routing 19c, which routing 19c extends along the frame (10, 11) formed by girdles 10 and 11. The switchboard 18 serves to connect the monitoring equipment, such as cameras 26 and MRU 28 of the lifting frame 2 with other control and data storage equipment, provided on a vessel 9 or other location. The data and control signals may be carried by a wireless connection between the switchboard 18 and the control and data storage equipment. A Wi-Fi antenna 18a may be provided for this purpose.

As shown in figure 5, the floating frame 1 and the lifting frame 2 may be positioned in an unassembled position, in which the feet 14 are not engaged with the receiver beams 25. The floating frame 1 and lifting frame 2 however are aligned such that when the

5 lifting frame 2 is lifted with the crane 6 in an upwards direction 80, the receiver beams 15 will at some point engage with the feet 14 of the floating frame 1 and take the latter with it. In this assembled or engaged position (shown in figure 6), the two frames (1, 2) form an assembly that can be lifted with the crane 6. During lifting by the crane 6, the lifting frame 2 supports the floating frame 1 being engaged with the receiving beams 25.

10 The poles 24 and receiver beams 25 are configured such as to release the floating frame 1 from the lifting frame 2 when the assembly (1, 2) is lowered onto the water surface 7. The lifting frame 2 may be lowered further towards the bottom 4, as shown in figures 7A to 7D), while the floating frame 1 will float on the water surface 7. Upon touching the water surface 7, the floating frame 1 and the lifting frame 2 are thus disengaged

15 from each other, during which disengaging the feet 14 are released from the receiver beams 25 by the upward force provided by buoyancy.

A method for lowering a protective slab 5 on a bottom 4 of a water basin by using the invented device may be illustrated with reference to figures 7A-7D and 8A-8B.

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As shown in figures 7A-7D, a (cross-section of a) quay wall 32 of a harbor comprises for illustrative purposes a number of caissons 30, filled with dredged material for instance. The caissons 30 may extend over several km in an alongside direction of the quay wall 32. The caissons 30 may rest on a foundation layer 33 if desired. As shown,

25 the foundation layer 33 may comprise a slope 34 at an end of it that points away from the shore.

At the toe of the quay wall 32, a plurality of reinforced concrete slabs 5 of rectangular size need to be positioned to form a scour protection. A plurality of prefabricated

30 reinforced concrete slabs 5 are adjacently positioned on top of the foundation layer 33 such that a gap may be left between edges of the slabs 5 in a direction along the quay wall 32.

With reference to figures 7A-7D, the slabs 5 are conveniently placed on top of the foundation layer 33 by a device in accordance with an embodiment of the invention. The device comprises a crane 6 operated from a vessel or pontoon 9, which is conveniently anchored to the quay wall 32 by ropes 70. The assembly of a lifting frame 2 and a floating frame 1, engaged with the lifting frame 2, is suspended by wires 60 from a crane boom 61 of the crane 6. A slab 5 is attached to the lifting frame 2 as disclosed above. The assembly (1, 2) is lowered towards the water surface 7 until the floating frame 1 meets the water surface 7 and is left behind floating on this surface. The lifting frame 2 is positioned just underneath the floating frame, as shown in figure 7A.

From this position, the lifting frame 2 is further lowered in the direction of the underwater bottom 4 until a height 71 is reached above bottom level, as shown in figure 7B. In this position, the floating frame 1 and lifting frame 2 are disconnected.

The floating frame 1, carrying the slab 5, is then brought closer to the quay wall 32, while simultaneously monitoring the position of the slab 5 with the monitoring means provided on the lifting frame 2, as elucidated above. This movement of the slab 5 towards the quay wall 32 is effectuated by rotating the crane boom 61 in a clockwise direction in accordance with arrow 62, as shown in figure 7C. This movement is carried through until the slab 5 (or at least the side facing the quay wall 32) is at a desired distance from the quay wall 32. The slab 5 also should have the right inclination (horizontal in this embodiment) and have a gap with a slab 5 already positioned on the foundation layer 33 that is not too large, not too small. In the process of accurate alignment, tugger lines 90, provided between the vessel 9 and the lifting frame 2 may be employed, in particular to be able to rotate the lifting frame 2 and slab 5 around a vertical axis in the direction 8.

The slab 5 is then further brought downwards until it reaches the top surface of the foundation layer 33 and is left to rest on this foundation layer 33, as shown in figure 7D. The slab 5 is then released from the lifting frame 2 and the latter brought upwards until it engages the floating frame 1, and another slab 5 is picked up by the assembly (1, 2), for instance from a storage on the vessel 9 or onshore.

Figures 8A and 8B finally illustrate an embodiment in which the lifting frame 2 is provided with a gripping beam 40 for manipulating an assembly of protective beams 50 and positioning this assembly on a slope 34 of the water basin bottom or foundation layer 33. The flexible assembly, comprising a plurality of concrete beams 50 that are
5 arranged parallel to each other and interconnected by ropes 51, extending between the beams 50 is engaged by hydraulically operable grippers 41 at both ends of the gripping beam 40. The gripping beam 40 is rotated around a horizontal axis 82 by using the hydraulic cylinders 42 from a position about horizontal (see figure 8A) to a downwardly rotated position (see figure 8B) in which the assembly of concrete beams 50 is laid
10 down on the slope 34. This embodiment allows to simultaneously position a slab 5 and an assembly of concrete beams 50 on a partly sloped surface.

CLAIMS

1. Device for lowering a protective slab on a bottom of a water basin, the device comprising
 - 5 - a lifting frame that can be suspended from a crane and lowered under water, and to which a slab can be releasably connected, the lifting frame further comprising monitoring equipment for establishing a position of the slab; and, associated with the lifting frame,
 - a floating frame that can be suspended from the crane together with the lifting
10 frame and lowered onto the water surface, the floating frame comprising buoyancy means and further auxiliary equipment for operating the monitoring equipment of the lifting frame.
2. Device according to claim 1, wherein the lifting frame comprises support means
15 for supporting the floating frame during lifting by the crane.
3. Device according to claim 2, wherein the support means are configured to release the floating frame from the lifting frame when in a floating position on the water surface.
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4. Device according to any one of the preceding claims, wherein the monitoring equipment of the lifting frame comprises underwater cameras.
5. Device according to any one of the preceding claims, wherein the auxiliary
25 equipment of the floating frame comprises water flushing means configured to carry clear water into a viewing volume of the monitoring equipment.
6. Device according to any one of the preceding claims, wherein the monitoring equipment of the lifting frame is positioned such that it covers corners of a slab
30 connected to the lifting frame.
7. Device according to any one of the preceding claims, wherein the monitoring equipment of the lifting frame further comprises motion sensors for monitoring a movement of the slab.

8. Device according to any one of the preceding claims, wherein the monitoring equipment of the lifting frame further comprises narrow beam echo sounders for establishing a misalignment of the slab in a horizontal plane and/or a distance to a wall,
5 such as a caisson wall.
9. Device according to any one of the preceding claims, wherein the lifting frame comprises a water-tight electrical unit, powered by a power unit, such as a diesel generator, for operating the monitoring equipment.
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10. Device according to any one of the preceding claims, wherein the auxiliary equipment of the floating frame comprises at least a generator for providing power, a switch board and an umbilical for connection with the lifting frame monitoring equipment.
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11. Device according to any one of the preceding claims, further comprising means for rotating the lifting frame in a horizontal plane when suspended from the crane.
12. Device according to claim 11, wherein the rotating means comprise tugger lines
20 associated with constant tension winches.
13. Device according to any one of the preceding claims, wherein the lifting frame further comprises a rotatable gripping beam for manipulating an assembly of protective beams and positioning on a slope of the water basin bottom.
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14. Assembly of a device according to any of the preceding claims, and a crane, provided on a support surface.
15. Method for lowering a protective slab on a bottom of a water basin, the method
30 comprising
- providing an assembly according to claim 14;
 - connecting a slab to the lifting frame of the device;
 - suspending the device from the crane;

- lowering the device provided with the slab to the bottom of the water basin, such that when reaching the water surface, the floating frame is released from the lifting frame and floats on the water surface, while the lifting frame lowers further;
- establishing the position of the submerged slab by means of the monitoring equipment; and
- releasing the slab from the lifting frame when in the desired position on the bottom of the water basin.