

DESCRIPTION

PERMANENT FORM FOR FORMING CONCRETE STRUCTURES

TECHNICAL FIELD

[0001]

The present invention relates to a form serving to form a concrete underground beam which supports an understructure portion or an underground portion of a building or a concrete sidewall of a storage tank storing rainwater and the like. More particular, it relates to a permanent form which remains on a surface of the underground beam or the sidewall. It is to be noted that the present international application claims priority based on Japanese Patent Application No. 190711 (Japanese Patent Application No. 2018-190711) filed on October 9, 2018 and the entire contents of Japanese Patent Application No. 2018-190711 are incorporated by reference into this international application.

BACKGROUND ART

[0002]

There has been conventionally disclosed a storage tank including a concrete bottom slab laid on a bottom portion of a hole dug in the ground, a storage complex provided on this bottom slab and accommodated in the hole, a concrete square cylindrical sidewall provided to surround the storage complex on the bottom slab, and a sidewall forming member

configured to form this sidewall into a square frame shape (for example, see Patent Document 1, claim 1, claim 5, paragraphs [0019] and [0023], and FIG. 1 and FIG. 3 to FIG. 5]. In this storage tank, the storage complex has a plurality of square plate-shaped partition plates each having at least one cylindrical rib protruded on a lower surface thereof and having at least one cylindrical rib protruded on an upper surface thereof, cylindrical spacers connected to one or both of the upper surface and the lower surface of each of these partition plates while being fitted to the cylindrical ribs, and an outermost layer portion provided by alternating arranging the partition plates and the spacers in a vertical direction on the outermost side of the storage complex. Further, the sidewall forming member has: a plurality of stages of interior forms formed into a square cylinder shape by arranging a plurality of first plate materials so as to come into contact with a plurality of spacers constituting the outermost layer portion at portions forming an outer surface of the outermost layer portion in accordance with each of stages between a plurality of stages of partition walls which constitute the outermost layer portion and are vertically arranged at intervals; a plurality of vertical reinforcements inserted into the plurality of stages of the partition plates, which constitute the outermost layer portion and are vertically arranged at intervals, so as to be placed on the outer side of the plurality of first plate materials; and a single stage of an exterior form which is

formed into a square cylinder shape by holding a plurality of second plate materials arranged on the outer side of the plurality of stages of partition plates, which constitute the outermost layer portion and are vertically arranged at intervals, at predetermined intervals from the vertical reinforcements with the use of a plurality of separators. Furthermore, the first plate materials are plastic cardboard materials, and the second plate materials are steel nettings.

[0003]

In the thus configured storage tank, pouring and hardening fresh concrete between the interior forms and the exterior forms enables forming the sidewall on an upper surface of the bottom slab, and storage complex constructing work, sidewall forming member constructing work, and sidewall forming work can be substantially simultaneously can be proceeded. Consequently, even an unskilled worker can form the concrete sidewall by a relatively simple method in a relatively short time. Moreover, even if a relatively large horizontal partial pressure of an earth pressure acts on an outer puerperal surface of the storage tank, the structurally robust concrete sidewall receives the partial pressure, and hence the storage complex can be prevented from being damaged. Additionally, since the concrete sidewall is supported by the storage complex in the storage tank, a thickness of the sidewall can be suppressed to the requisite minimum. Further, the plastic cardboard material which is relatively light in weight and has relatively high strength

is used as each first plate material, the steel netting which is relatively light in weight and has relatively high strength is used as each second plate material, and hence conveyance and installment of the first plate materials and the second plate materials can be relatively easily carried out.

CITATION LIST

PATENT LITERATURE

[0004]

Patent Document 1: International Publication
WO2017/073546

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005]

In the storage tank disclosed in Patent Document 1, since the steel netting is prone to deform and has no self-standing property, there is a drawback that many steps are required to hold this vertically erected steel netting by the separators. Furthermore, in the storage tank disclosed in Patent Document 1, when this storage tank is entirely installed on the ground or when a lower portion of the storage tank is buried underground and an upper portion of the same is exposed on the ground, there is also a problem that an appearance of the outer peripheral surface of the storage tank is impaired.

[0006]

On the other hand, there is a method for piling up bricks to form the exterior form, but the piled-up bricks have a self-standing structure without being supported by the separators, and hence casting a large amount of the fresh concrete between the interior form and the exterior form at a time results into collapse of the brick-built exterior form. Thus, there is a problem that work of casting and hardening a small amount of the fresh concrete between the interior form and the exterior form and again casting and hardening a small amount of the same must be repeated.

[0007]

A first object of the present invention is to provide a permanent form for forming concrete structures, which has self-standing properties and enables readily assembling a robust exterior form or both the exterior form and an interior form. A second object of the present invention is to provide a permanent form for forming concrete structures, which can improve an appearance of a storage tank in case of installing the entire storage tank on the ground or installing the storage tank in such a manner that a lower portion of the storage tank is buried in the ground and an upper portion of the same protrudes on the ground. A third object of the present invention is to provide a permanent form for forming concrete structures, which enables easily and inexpensively fabricating base plates constituting an exterior form or both the exterior form and an interior form, central reinforcement

plates, end reinforcement plates, and the like. A fourth object of the present invention is to provide a permanent form for forming concrete structures, which enables very easily holding an exterior form or both the exterior form and an interior form and enables assuredly preventing a deformation of the exterior form and the interior form even if fresh concrete is casted between the interior form and the exterior form at a time.

SOLUTION TO PROBLEM

[0008]

As shown in FIG. 1 to FIG. 4, according to a first aspect of the present invention, there is provided a permanent form 13 which is provided to form a concrete structure constituted of a concrete sidewall 11 erected on a concrete bottom slab 12 laid on a bottom portion of a hole dug in the ground or on the ground, and remains on a surface of the sidewall 11, including: an interior form 14 forming an inner face of the sidewall 11; an exterior form 16 forming an outer face of the sidewall 11, and a plurality of vertical reinforcements 17 which are arranged between the interior form 14 and the exterior form 16 and hold the exterior form or both the exterior form 16 and the interior form 14, in which the exterior form or both the exterior form 16 and the interior form 14 have: a plurality of base plates 18 which are formed into a square plate shape with the use of plastic and closely aligned in the vertical and horizontal directions; a

plurality of central reinforcement plates 19 which are formed into a square plate shape substantially equal to that of the base plates 18 in size with the use of plastic, couple four adjacent base plates 18, and closely aligned in the vertical and horizontal directions; and a plurality of end reinforcement plates 21 which are formed into a rectangular plate shape with the use of plastic, placed on outer edges of the plurality of central reinforcement plates 19 closely aligned in the vertical and horizontal directions, and aligned in a square frame shape while coupling adjacent base plates 18.

[0009]

A second aspect of the present invention is characterized by, in the invention based on the first aspect, as further shown in FIG. 3(b) and FIG. 9, that plastic decorative plates 34 are mounted on surfaces of the plurality of central reinforcement plates 19 respectively, and a pattern 34b is raised or indented on a surface of each of the decorative plates 34.

[0010]

A third aspect of the present invention is characterized by, in the invention based on the first or second aspect, as further shown in FIG. 1, that the sidewall 11 is a concrete underground beam which is buried in the ground and provided on the bottom slab 12 to support a building, an outer face of this underground beam 11 is formed of the exterior form 16, and an inner face of the underground beam

11 is formed of the interior form 14.

[0011]

A fourth aspect of the present invention is characterized by, in the invention based on the first or second aspect, as further shown in FIG. 10 to FIG. 13, that the side wall 51 is a concrete square cylindrical sidewall provided on the bottom slab 52 to surround a rectangular parallelepiped storage complex 55 for forming a storage tank 50, and an outer face of this sidewall 51 is formed of the exterior form 16.

ADVANTAGEOUS EFFECTS OF INVENTION

[0012]

In the permanent form according to the first aspect of the present invention, the exterior form or both the exterior form and the interior form are formed by coupling the base plates, the central reinforcement plates, and the end reinforcement plates in the vertical and horizontal directions, the plurality of vertical reinforcements are disposed between the interior form and the exterior form, the exterior form or both the exterior form and the interior form are held by these vertical reinforcements, and hence the exterior form or both the exterior form and the interior form having the self-standing properties and robustness can be easily assembled. Consequently, even if a large amount of the fresh concrete is poured between the interior form and the exterior form at a time, a concrete sidewall having

a predetermined shape can be formed without deforming the exterior form or both the exterior form and the interior form. Further, since the base plates, the central reinforcement plates, and the end reinforcement plates are made of plastic, the base plates, the central reinforcement plates, and the end reinforcement plates constituting the exterior form or both the exterior form and the interior form can be easily fabricated. Furthermore, forming the base plates, the central reinforcement plates, and the end reinforcement plates with the use of waste plastic enables inexpensively fabricating the base plates, the central reinforcement plates, and the end reinforcement plates constituting the exterior form or both the exterior form and the interior form.

[0013]

In the permanent form according to the second aspect of the present invention, the decorative plates made of plastic are mounted on the surfaces of the plurality of central reinforcement plates respectively, the pattern is raised or indented on the surfaces of the decorative plates, and hence the decorative plates each having the pattern raised or indented on the surfaces thereof are exposed when the sidewall is formed on the ground. Consequently, the appearance of the surface of the sidewall can be improved.

[0014]

In the permanence frame according to the third aspect of the present invention, since the sidewall is the concrete underground beam which is buried in the ground and provided

on the bottom slab to support a building and the outer face of this underground beam is formed of the exterior form whilst the inner face of the underground beam is formed of the interior form, the exterior form and the interior form are formed by coupling the base plates, the central reinforcement plates, and the end reinforcement plates in the vertical and horizontal directions, the plurality of vertical reinforcements are arranged between the interior frame and the exterior frame, and the exterior form and the interior form are held by these vertical reinforcements. Consequently, the exterior form and the interior form which have the self-standing properties and the robustness can be easily assembled. Further, even if a large amount of the fresh concrete is poured between the interior frame and the exterior frame at a time, the concrete sidewall having a predetermined shape can be formed without deforming the exterior form and the interior form.

[0015]

In the permanent form according to the fourth aspect of the present invention, since the sidewall is the concrete square cylindrical sidewall which is provided to surround the rectangular parallelepiped storage complex on the bottom slab for forming the storage tank and the outer face of this sidewall is formed of the exterior form, the exterior form is formed by coupling the base plates, the central reinforcement plates, and the end reinforcement plate in the vertical and horizontal directions, the plurality of

vertical reinforcements are arranged between the interior form and the exterior form, and the exterior form is held by these vertical reinforcements. Consequently, the exterior form having the self-standing properties and the robustness can be easily assembled. It is to be noted that the interior form is assembled to the outer peripheral surface of the storage complex assembled on the bottom slab. Furthermore, as compared with a case where the steel netting or the bricks are used as the exterior form, assembling work of the exterior form can be greatly reduced and, even if a large amount of the fresh concrete is poured between the interior form and the exterior form at a time, the concrete sidewall having a predetermined shape can be formed without deforming the exterior form. Moreover, in a case where the entire storage tank is installed on the ground or the storage tank is installed in such a manner that the lower portion thereof is buried in the ground and the upper portion thereof is protruded on the ground, mounting the decorative plates on the surfaces of the central reinforcement plates of the exterior form protruded on the ground enables improving the appearance of the surface of the storage tank.

BRIEF DESCRIPTION OF DRAWINGS

[0016]

FIG. 1 is a cross-sectional view of a primary part showing a state where an underground beam is formed with the use of a permanent form for forming concrete structures

according to a first embodiment of the present invention;

FIG. 2(a) is a front view showing a basic assembling procedure for base plates of an exterior form or an interior form of the permanent form, and (b) is a front view showing a basic procedure for coupling the adjacent base plates by a central reinforcement plate;

FIG. 3(a) is a front view showing a basic procedure for placing end reinforcement plates on outer edges of the central reinforcement plate which couples the adjacent base plates and coupling the adjacent base plates by the end reinforcement plates, and (b) is a front view showing a basic procedure for mounting a decorative plate on a surface of the central reinforcement plate;

FIG. 4 is a front view showing a halfway state of assembling the exterior frame or the interior frame of an underground beam with the use of the base plates, the central reinforcement plates, and the end reinforcement plates;

FIG. 5 is a transverse cross-sectional view of a primary part showing a connecting structure of the exterior forms at a portion where the exterior forms become orthogonal to each other;

FIG. 6(a) is a perspective view of the base plate seen from a front surface side, and (b) is a perspective view of the base plate seen from a back surface side;

FIG. 7(a) is a perspective view of the central reinforcement plate seen from the front surface side, and (b) is a perspective view of the central reinforcement plate

seen from the back surface side;

FIG. 8(a) is a perspective view of the end reinforcement plate seen from the front surface side, and (b) is a perspective view of the end reinforcement plate seen from the back surface side;

FIG. 9(a) is a perspective view of the decorative plate seen from the front surface side, and (b) is a perspective view of the decorative plate seen from the back surface side;

FIG. 10 is an enlarged cross-sectional view of a portion A in FIG. 13, showing a state where a sidewall of a storage tank buried in the ground is formed with the use of a permanent form for forming concrete structures according to a second embodiment of the present invention;

FIG. 11 is a cross-sectional view taken along a line B-B in FIG. 13;

FIG. 12 is a front view showing a halfway state of assembling an exterior form of the storage tank with the use of base plates, central reinforcement plates, and end reinforcement plates;

FIG. 13 is a longitudinal cross-sectional view of a storage facility including this storage tank; and

FIG. 14 is a front view of the exterior form, showing a state where decorative plates are mounted on a sidewall of an upper half of a storage tank which is installed in such a manner that a lower portion thereof is buried in the ground and an upper portion thereof is protruded on the ground using a permanent form for forming concrete structures according

to a third embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0017]

Embodiments of the present invention will now be described with reference to the drawings.

[0018]

<First Embodiment>

As shown in FIG. 1, in this embodiment, a concrete sidewall 11 which is a concrete structure is a concrete underground beam which supports an understructure portion or an underground portion of a building, and this underground beam 11 is erected in a square frame shape on a concrete square plate-shaped bottom slab 12 laid on a bottom portion of a hole dug in the ground. The underground beam 11 is formed of a permanent form 13 remaining on a surface of this underground beam 11, i.e., an outer face and an inner face of the underground beam 11. This permanent form 13 includes an interior form 14 forming the inner face of the underground beam 11, an exterior form 16 forming the outer face of the underground beam 11, and a plurality of vertical reinforcements 17 which are arranged between the interior form 14 and the exterior form 16 and hold the exterior form 16 and the interior form 14.

[0019]

The exterior form 16 and the interior form 14 are plane-symmetrically formed of the same components (FIG. 1).

Each of the exterior form 16 and the interior form 14 has a plurality of base plates 18 which are formed into a square plate shape using plastic and closely aligned in the vertical and horizontal directions, a plurality of central reinforcement plates 19 which are formed into a square plate shape substantially equal to that of the base plate 18 in size with the use of the plastic, couple the adjacent four base plates 18, and are closely aligned in the vertical and horizontal directions, and a plurality of end reinforcement plates 21 which are formed into a rectangular plate shape using the plastic, placed on outer edges of the plurality of central reinforcement plates 19 closely aligned in the vertical and horizontal directions, couple the adjacent base plates 18, and aligned in a square frame shape (FIG. 1 to FIG. 4). The base plates 18, the central reinforcement plates 19, and the end reinforcement plates 21 are made of a polyolefin resin (polypropylene, polyethylene, and the like), a vinyl chloride resin, and the like.

[0020]

The base plate 18 is preferably formed into a square plate shape which is 20 cm to 80 cm on a side and has a thickness of 4 cm to 8 cm. Further, the base plate 18 has a base plate body 18a formed into a square plate shape, four base plate coupling holes 18b each formed at a substantial center of a divided square plate when this base plate body 18a is divided into four square plates, four cylindrical ribs 18c which are protruded on a side facing the central reinforcement plate

19 or the end reinforcement plate 21 of both sides of the base plate body 18a and surround the peripheries of the four base plate coupling holes 18b respectively, and a frame-shaped protrusion 18d which is protruded on an opposite side of a side facing the central reinforcement plate 19 or the end reinforcement plate 21 of both the sides of the base plate body 18a and formed into a square frame shape extending along an outer edge of the base plate body 18a (FIG. 1 and FIG. 6). Furthermore, on an outer peripheral surface of the base plate 18, i.e., an outer face of the frame-shaped protrusion 18d, concave portions 18e and convex portions 18f are alternately formed in a checkerboard pattern (a checker pattern) in two rows in the thickness direction of the base plate 18 and four rows in the longitudinal direction of the base plate in accordance with each of four sides (FIG. 6). A height of the cylindrical ribs 18c is formed to be substantially equal to a thickness of each of an exterior corner portion connecting plate 22 (FIG. 5) and an interior corner portion connecting plate (not shown) which will be described later.

[0021]

Further, the plurality of base plates 18 are closely aligned within the same vertical plane in the vertical and horizontal directions (FIG. 2 to FIG. 4). In this instance, the concave portions 18e and the convex portions 18f formed on the outer face of the frame-shaped protrusion 18d of the base plate 18 are loosely fitted onto and loosely inserted

into the convex portions 18f and the concave portions 18e formed on the outer face of the frame-shaped protrusion 18d of an adjacent base plate 18, respectively. Consequently, the base plate 18 and the adjacent base plate 18 can be prevented from moving within an interface thereof, namely, the base plate 18 and the adjacent base plate 18 can be prevented from relatively moving in the longitudinal direction and the thickness direction thereof. Moreover, the concave portions 18e and the convex portions 18f formed on the outer face of the frame-shaped protrusion 18d of the base plate 18 are loosely fitted on and loosely inserted into the convex portions 18f and the concave portions 18e formed on the outer face of the frame-shape protrusion 18d of an upper or lower base plate 18, respectively. In this case, likewise, the base plate 18 and the upper or lower base plate 18 can be prevented from moving within an interface thereof.

[0022]

Reference numeral 18g in FIG. 1 and FIG. 6(b) denotes a horizontal reinforcement rib which is provided to horizontally extend in the frame-shaped protrusion 18d, and reference numeral 18h in FIG. 6(b) denotes a vertical reinforcement rig which is provided to vertically extend in the frame-shaped protrusion 18d. In this embodiment, a plurality of locking holes 18i are formed in the horizontal reinforcement rib 18g and vertical two sides of the four sides of the frame-shaped protrusion 18d of the base plate 18 at predetermined intervals. Additionally, one end of a

later-described exterior separator 24 is locked on an exterior vertical reinforcement 17a of the vertical reinforcements 17 whilst the other end of the same is locked in the locking hole 18i of the base plate 18 forming the exterior form 16, and one end of a later-described inner separator 26 is locked on an interior vertical reinforcement 17b of the vertical reinforcement 17 whilst the other end is locked in the locking hole 18i of the base plate 18 forming the interior form 14. It is to be noted that locking holes may be provided in the horizontal reinforcement rib and the vertical reinforcement rib, and the locking holes may be provided in all the four sides of the frame-shaped protrusion. In this case, the upper, lower, left, and right sides of the base plate are not distinguished, and construction work for the base plates can be facilitated.

[0023]

The central reinforcement plate 19 is preferably formed into a square plate shape which is 20 cm to 80 cm on a side and has a thickness of 3 cm to 6 cm (FIG. 1 and FIG. 7). Further, the central reinforcement plate 19 has a central reinforcement plate body 19a formed into a square plate shape, four central coupling pins 19b protruded on a side facing the base plate 18 of both sides of the central reinforcement plate body 19a, a square decorative plate accommodating concave portion 19c formed at the center of an opposite side of a side facing the base plate 18 of both the sides of the central reinforcement plate body 19a. Furthermore, each of

the four central coupling pins 19b is formed at a substantial center of a divided square plate when the central reinforcement plate body 19a is divided into four square plates. Consequently, in a state where the adjacent four base plates 18 are closely aligned in the vertical and horizontal directions (FIG. 2), inserting the four central coupling pins of the central reinforcement plate 19 into the base plate coupling holes 18b of the four base plates respectively in such a manner that the central reinforcement plate 19 is placed at the center of the four base plates 18 and overlaps one corner of each of the four base plates 18 enables coupling the four base plates 18 by the central reinforcement plate 19 (FIG. 2(b) and FIG. 3(a)). Here, the central coupling pins 19b are press-fitted or driven into the base plate coupling holes 18b and configured to be prevented from being easily removed by vibration or the like. It is to be noted that reference numeral 19d in FIG. 7(b) denotes lightweight concave portions formed on a side facing the base plate 18 of both the sides of the central reinforcement plate body 19a, and reference numeral 19e denotes reinforcement ribs protruded in the lightweight concave portions 19d in the vertical and horizontal directions. Further, reference numeral 19f in FIG. 2(b), FIG. 3, FIG. 4, and FIG. 7 denote four through holes for mounting a decorative plate 34. Furthermore, the concave portions and the convex portions having a checkerboard pattern (a checker pattern) formed on the outer peripheral surface of the base

plate 18, i.e., the outer peripheral surface of the frame-shaped protrusion 18d are not formed on the outer peripheral surface of the central reinforcement plate 19. [0024]

On the other hand, the end reinforcement plate 21 is formed into a rectangular plate shape whose longer sides have a length which is 1.5 times the central reinforcement plate 19, whose shorter sides have a length which is 0.5 times the central reinforcement plate 19, and whose thickness is the same as a thickness of the central reinforcement plate 19 (FIG. 1, FIG. 3, FIG. 4, and FIG. 8). Moreover, the end reinforcement plate 21 has an end reinforcement plate body 21a formed into a rectangular plate shape, and three end coupling pins 21b protruded toward the base plate 18 on both sides of the end reinforcement plate body 21a (FIG. 1, FIG. 5, and FIG. 8(b)). Additionally, each of the three end coupling pins 21b is formed at a substantial center of a divided square plate when the end reinforcement plate body 21a is divided into square plates each side of which is a short side of the end reinforcement plate body 21a. Consequently, in a state where the four base plates 18 are coupled by one central reinforcement plate 19, the two end coupling pins 21b of the three end coupling pins 21b of the end reinforcement plate 21 are inserted into the base plate coupling holes 18b of one base plate 18 respectively and the one remaining end coupling pin 21b is inserted into the base plate coupling hole 18b of the base plate 18 adjacent to this

base plate 18 in such a manner that one end reinforcement plate 21 is placed on the outer edge of one central reinforcement plate 19, whereby the two plate plates 18 are coupled in such a manner that the one end reinforcement plate 21 overlaps the two base plates 18 (FIG. 3(a)). When the same work as that described above is repeated, the three end reinforcement plates are placed on the outer edge of the one central reinforcement plate and aligned in a square frame shape while coupling the adjacent base plates (FIG. 3(b)). In this embodiment, as shown in FIG. 4, the plurality of end reinforcement plates 21 are placed on the outer edges of the plurality of central reinforcement plates 19 closely extending in the horizontal direction and aligned in a square frame shape while coupling the adjacent base plates 18. Here, the end coupling pins 21b are press-fitted or driven into the base plate coupling holes 18b, and configured so that they can be prevented from being easily removed by vibration or the like.

[0025]

It is to be noted that reference numeral 21c in FIG. 8(a) denotes an engagement convex stripe protruded on one short side of a pair of short sides of the end reinforcement body 21a, and reference numeral 21d in FIG. 8(b) denotes a short-side engagement concave stripe indented on the other short side of the pair of short sides of the end reinforcement plate body 21a. Further, reference numeral 21e in FIG. 8 denotes a long-side engagement concave stripe formed on each

of both end portions of a pair of long sides of the end reinforcement plate body 21a. When the engagement convex stripe 21c engages with the short-side engagement concave stripe 21d or the long-side coupling concave stripe 21e, the movement of the engage reinforcement plates 21, 21 in the thickness direction is avoided. Furthermore, reference numeral 21f in FIG. 8(b) denotes a lightweight concave portion formed on a side facing the base plate 18 of both the sides of the end reinforcement plate body 21a, and reference numeral 21g in FIG. 8(a) denotes a plurality of lightweight concave portions formed in the longitudinal direction on an opposite side of the side facing the base plate 18 of both the sides of the end reinforcement plate body 21a.

[0026]

On the other hand, the plurality of vertical reinforcements 17 have a plurality of exterior vertical reinforcements 17a which hold exterior form 16 using the exterior separators 24 and are erected at intervals in the longitudinal direction of the exterior form 16, and a plurality of interior vertical reinforcements 17b which hold the interior form 14 using interior separators 26 and are erected at intervals in the longitudinal direction of the interior form 14 (FIG. 1). The exterior separators 24 and the interior separators 26 are formed into the same shape with the same size. An exterior reinforcement 28 is assembled by coupling the plurality of exterior vertical

reinforcements 17a and a plurality of exterior horizontal reinforcements 27 in a lattice pattern with the use of a binding wire or welding, and an interior lattice reinforcement 31 is assembled by assembling the plurality of interior vertical reinforcements 17b and a plurality of interior horizontal reinforcements 29 in a lattice pattern with the use of the binding wire or the welding. A reinforcement temporary assembly 32 assembled by crossing a plurality of reinforcements narrower than these vertical reinforcements 28, 31 in the vertical, horizontal, and height directions using the binding wire or the welding is provided between the plurality of exterior vertical reinforcements 17a and the plurality of interior vertical reinforcements 17b, i.e., between the exterior lattice reinforcement 28 and the interior lattice reinforcement 31. Furthermore, the plurality of exterior lattice reinforcements 28 are coupled with an outer face of the reinforcement temporary assembly 32 using the binding wire or the welding, and the plurality of interior lattice reinforcements 31 are coupled with an inner face of the reinforcement temporary assembly 32 by the binding wire or the welding, thereby fabricating a reinforcement assembly 33. A lower portion of this reinforcement assembly 33 is buried in the concrete bottom slab 12. Moreover, it is preferable to form the exterior separators 24 and the interior separators 26 by bending a metal wire such as a wire at a construction site or using

a metal rod of carbon steel or the like bent into a predetermined shape in advance.

[0027]

It is to be noted that, as shown in FIG. 5, the exterior forms 16, 16 abutting on each other at a right angle are connected through the exterior corner portion connecting plate 22 having a substantially L-like shape as seen in a plan view. One flat plate portion 22a of this exterior corner portion connecting plate 22 is inserted between the base plate 18 and the end reinforcement plate 21 constituting an end portion of one exterior form 16, and the other flat plate portion 22b is inserted between the base plate 18 and the end reinforcement plate 21 constituting an end portion of the other exterior form 16. Additionally, the interior forms 14, 14 abutting on each other at a right angle are connected through an interior corner portion connecting plate (not shown) having a substantially L-like shape as seen in a plan view. One flat plate portion (not shown) of this interior corner portion connecting plate is inserted between the base plate 18 and the end reinforcement plate 21 constituting an end portion of one interior form 14, and the other flat plate portion (not shown) is inserted between the base plate 18 and the end reinforcement plate 21 constituting an end portion of the other interior form 14. Further, as shown in FIG. 3(b), the plastic decorative plate 34 may be mounted on a surface of the central reinforcement plate 19. In this embodiment, the decorative plate 34 has a decorative plate

body 34a formed into a substantially square plate shape, a pattern 34b which is raised on a surface of this decorative plate body 34a and constituted of Mount Fuji and the sun, and four mounting pins 34c which are protruded on a back side of the decorative plate body 34a and inserted into the four through holes 19f of the central reinforcement plate 19 (FIG. 3(b) and FIG. 9). When the underground beam 11 is exposed on the surface of the ground, mounting this decorative plate 34 on the surface of the central reinforcement plate 19 of the exterior form 16 enables improving the appearance of the underground beam 11. Here, the mounting pins 34c are press-fitted or driven into the through holes 19f and configured so that they cannot be easily removed by vibration or the like. The exterior corner portion connecting plate 22, the interior corner portion connecting plate, and the decorative plate 34 are made of a polyolefin resin (polypropylene, polyethylene, and the like), a vinyl chloride resin, and the like. Furthermore, it is preferable to form the exterior corner portion connecting plate 22 and the interior corner portion connecting plate with a thickness of approximately 1 cm to 2 cm and form the decorative plate 34 with a thickness of approximately 0.4 cm to 1.2 cm.

[0028]

A description will now be given on an assembling procedure of the thus configured underground beam 11. First, a hole having a bottom portion larger than the bottom slab 12 is dug in the ground, and the reinforcement assembly 33

is placed in a square frame shape on the bottom portion of this hole. Then, the fresh concrete is poured into the bottom portion of the hole, and the concrete bottom slab 12 having the square plate shape is formed on the bottom portion of the hole. At this moment, a lower portion of the reinforcement assembly 33 is buried in the bottom slab 12. Subsequently, on the bottom slab 12, the exterior form 16 is formed by coupling the base plates 18, the central reinforcement plates 19, and the end reinforcement plates 21 in the vertical and horizontal directions as shown in FIG. 1 to FIG. 4, and the interior form 14 is formed by coupling the base plates 18, the central reinforcement plates 19, and the end reinforcement plates 21 in the vertical and horizontal directions as shown in FIG. 1 to FIG. 4. Additionally, the exterior frame 16 is placed on the outer side of the reinforcement assembly 33 at a predetermined interval, ends of the exterior separators 24 on one side are locked on the exterior horizontal reinforcements 27 of the exterior lattice reinforcement 28, and ends of the exterior separators 24 on the other side are locked in the locking holes 18i of the base plates 18 of the exterior form 16 (FIG. 1). Consequently, the exterior form 16 is held by the plurality of exterior vertical reinforcements 17a through the plurality of exterior separators 24 and the plurality of exterior horizontal reinforcements 27. Further, the interior form 14 is placed on the inner side of the reinforcement assembly 33 at a predetermined interval, ends

of the interior separators 26 on one side are locked on the interior horizontal reinforcements 29 of the interior lattice reinforcement 31, and ends of the interior separators 26 on the other side are locked in the locking holes 18i of the base plates 18 of the interior form 14. Consequently, the interior form 14 is held by the plurality of interior vertical reinforcements 17b through the plurality of interior separators 26 and the plurality of interior horizontal reinforcements 29.

[0029]

Then, as shown in FIG. 5, the exterior forms 16, 16 abutting on each other at a right angle are connected through the exterior corner portion connecting plate 22, and the interior forms 14, 14 abutting on each other at a right angle are connected through the interior corner portion connecting plate. In the thus assembled permanent form 13, as compared with a case where the exterior forms and the interior forms are formed using the steel netting, plywood, and the like, the work for assembling the exterior form 16 and the interior form 14 can be greatly shortened. That is, the exterior form 16 and the interior form 14 having the self-standing properties and the robustness can be easily assembled. Furthermore, the fresh concrete is poured and hardened between the interior form 14 and the exterior form 16 to form the underground beam 11 (FIG. 1). At this moment, even if a large amount of the fresh concrete is poured between the interior forms 14 and the exterior forms 16, the exterior

vertical reinforcements 17a hold the exterior form 16 through the exterior separators 24, the interior vertical reinforcements 17b hold the interior frame 14 through the interior separators 26, and hence the concrete underground beam 11 having a predetermined shape can be formed without deforming the exterior form 16 and the interior form 14. Moreover, since the base plates 18, the central reinforcement plates 19, and the end reinforcement plates 21 are made of plastic, the base plates 18, the central reinforcement plates 19, and the end reinforcement plates 21 constituting the exterior form 16 and the interior form 14 can be easily fabricated. Additionally, when the base plates 18, the central reinforcement plates 19 and the end reinforcement plates 21 are formed using waste plastic, the base plates 18, the central reinforcement plates 19, and the end reinforcement plates 21 constituting the exterior form 16 and the interior form 14 can be inexpensively fabricated.

[0030]

<Second Embodiment>

FIG. 10 to FIG. 13 show a second embodiment of the present invention. In FIG. 10 to FIG. 13, reference numerals equal to those in FIG. 1 to FIG. 8 denote the same parts. In this embodiment, a sidewall 51 is a concrete square cylindrical sidewall provided to surround a rectangular parallelepiped storage complex 55 on a bottom slab 52 to form a storage tank 50, and an outer surface of this sidewall 51 is formed of each exterior form 56 of a permanent form 53.

The bottom slab 52 is laid on a bottom portion of a hole 59 dug in the ground. The sidewall 51 is formed into a square frame shape with the use of the permanent frame 53 having the exterior frame 56, each interior frame 54, and a plurality of vertical reinforcements 57. As shown in FIG. 10 and FIG. 11, the storage complex 55 has a plurality of stages of horizontal connecting bodies 61 to 64 on a plurality of stages constituted by aligning and connecting a plurality of square plate-shaped partition plates 58 within a horizontal plane, a plurality of cylindrical spacers 66 connected to either one or both of a lower surface and an upper surface of each of the plurality of partition plates 58, and an outermost layer portion 67 provided by alternately arranging the partition plates 58 and the spacers 66 in the vertical direction on the outermost side of the storage complex 55. Further, at least one cylindrical rib 58a, 58b is protruded on a lower surface of each partition plate 58, and at least one cylindrical rib 58c, 58d is protruded on an upper surface of the same. Furthermore, each cylindrical spacer 66 is fitted to each of the cylindrical ribs 58a to 58b and thereby connected to one or both of the lower surface and the upper surface of each partition plate 58.

[0031]

In this embodiment, two ribs which are the first cylindrical rib 58a having a small diameter and the second cylindrical rib 58b having a large-diameter are concentrically formed on the lower surface of the partition

plate 58, and two ribs which are the third cylindrical rib 58c having a small diameter and the fourth cylindrical rib 58d having a large diameter are concentrically formed on the upper surface of the partition plate 58 (FIG. 10). The diameter of the first cylindrical rib 58a and the diameter of the third cylindrical rib 58c are equally formed, and the diameter of the second cylindrical rib 58b and the diameter of the fourth cylindrical rib 58d are equally formed. Furthermore, an insertion hole 58e into which a later-described spindle pipe 68 can be inserted is formed at a center of the partition plate 58 (FIG. 10 and FIG. 11). Reference numeral 58f in FIG. 11 denotes a plurality of flow holes which are formed in the partition plate 58 and through which rainwater 70 (FIG. 13) can pass. It is to be noted that, although not shown, engaged holes are formed at four corner portions of the partition plate 58 respectively, and a first engaging protrusion 71a of a first coupling piece 71 formed into a square plate shape or a second engaging protrusion (not shown) of a second coupling piece (not shown) formed into a rectangular plate shape is configured to enable engagement with each of these engaged holes. That is, the plurality of partition plates 58 placed within the same horizontal plane are coupled by the first coupling pieces 71 or the second coupling pieces. Specifically, the respective corner portions of the four partition plates 58 adjacent to each other within the same horizontal plane are coupled with each other by the first coupling pieces 71, and

the respective corner portions of the two adjacent partition plates 58 placed on the outermost side within the same horizontal plane are coupled with each other by the second coupling pieces. Moreover, it is preferable to form the partition plates 58, the first coupling pieces 71, and the second coupling pieces into a square plate shape which is approximately 20 cm to 40 cm on a side with the use of a polyolefin resin (polypropylene, polyethylene, and the like), a vinyl chloride resin, and the like.

[0032]

In this embodiment, each of the spacers 66 is formed into a cylindrical shape and constituted in such a manner that an upper end thereof is fitted to the large-diameter second cylindrical rib 58b of the partition plate 58 and a lower end thereof is fitted to the large-diameter fourth cylindrical portion 58d of another partition plate 58 (FIG. 10). Additionally, a plurality of flow holes 66a through which the rainwater 70 (FIG. 13) can pass are formed on an outer peripheral surface of each spacer 66. It is preferable to form the spacers 66 using plastic which is the same as the material of the partition plates 58.

[0033]

On the other hand, concave portions 58g and convex portions 58h in two rows in the thickness direction of the partition plate 58 and four rows in the longitudinal direction of the partition plate 58 are alternately formed in a checkerboard pattern (a checker pattern) on the outer

peripheral surface of the partition plate 58 in accordance with each of the four sides (FIG. 11). Further, aligning and connecting the plurality of the partition plates 58 with each other within the same horizontal plane enables constituting horizontal connecting bodies 61 to 64. In this instance, the concave portions 58g and the convex portions 58h of the partition plate 58 are loosely fitted on and loosely inserted into the convex portions 58h and the concave portions 58g of the adjacent partition plate 58, respectively. Consequently, the partition plate 58 and the adjacent partition plate 58 can be prevented from moving on their interface.

[0034]

In this embodiment, the horizontal connecting bodies 61 to 64 are formed on four stages, and they consist of the first horizontal connecting body 61 on the lowermost stage, the second horizontal connecting body 62 on a second stage from the bottom, the third horizontal connecting body 63 on a third stage from the bottom, and the horizontal connecting body 64 on a fourth stage from the bottom (the uppermost stage) (FIG. 13). Each of the first, third, and the fourth horizontal connecting bodies 61, 63, and 64 is formed into a square plate shape, and the second horizontal connecting body 62 is formed into a square frame shape. Furthermore, in this embodiment, the outermost layer portion 67 is provided on the outermost side of the storage complex 55, and an interior outer layer portion 69 is provided to be

adjacent to the inner side of this outermost layer portion 67. The outermost layer portion 67 and the interior outer layer portion 69 are constituted by alternately arranging the partition plates 58 and the spacers 66 in the vertical direction. That is, the outermost layer portion 67 and the interior outer layer portion 69 include not only the partition plates 58 and the spacers 66 stacked in the vertical direction between the partition plate 58 constituting the first horizontal connecting body 61 on the lowermost stage and the partition plate 58 constituting the fourth horizontal connecting body 64 on the uppermost stage but also the partition plate 58 constituting the first horizontal connecting body 61 and the partition plate 58 constituting the fourth horizontal connecting body 64 on the uppermost stage. Furthermore, the partition plates 58 on the inner side of the interior outer layer 69 are arranged at an interval of one stage in the vertical direction. Consequently, the second horizontal connecting body 62 is formed into a square frame shape consisting of the partition plates 58 alone constituting the outermost layer portion 67 and the interior outer layer portion 69 without arranging the partition plates 58 on the inner side of the interior outer layer portion 69.

[0035]

On the other hand, the interior form 54 of the permanent form 53 is formed into a square cylindrical shape by arranging a plurality of interior plates 54a, and the exterior form 56 is formed into the same shape with the same size as the

exterior form in the first embodiment. Moreover, the vertical reinforcements 57 have exterior vertical reinforcements 57a which constitute the outermost layer portion 67 and are inserted into through holes (not shown) formed in the partition plates 58 so that they are placed on the outer side of the interior form 54 on the respective partition plates 58 of the first to fourth horizontal connecting bodies 61 to 64. Additionally, ends of the exterior separators 24 on one side are locked on the exterior horizontal reinforcements 27 forming the exterior lattice reinforcement 28 together with the exterior vertical reinforcements 57a, and ends of the same on the other end are locked in locking holes 18i of the base plates 18 of the exterior form 56, whereby the exterior form 56 is held by the exterior vertical reinforcements 57a through the exterior separators 24 and the exterior horizontal reinforcements 27. The interior form 54 is formed into a square cylindrical shape by arranging interior plates 54a in accordance with each stage of the first to fourth horizontal connecting bodies 61 to 64 which constitute the outermost layer portion 67 and are arranged at intervals in the vertical direction in such a manner that these plates come into contact with portions of the plurality of spacers 66, which form outer faces of the outermost layer portion 67, constituting the outermost layer portion 67, namely, that they come into line contact with these outer faces while surrounding all of the plurality of spacers 66 constituting

the outermost layer portion 67 (FIG. 10 and FIG. 11). It is preferable to form each interior plate 54a by using a polypropylene plastic carboard which is relatively light in weight and has relatively high strength, and the interior plates 54a adjacent to each other are arranged to partially overlap (FIG. 11). Here, a plurality of auxiliary receiving members 72 which receive the interior forms 54 together with the spacers 66 constituting the outermost layer portion 67 are preferably inserted into flow holes 58f of the partition walls 58 constituting the outermost layer portion 67. This auxiliary receiving member 72 is preferably formed of a vinyl chloride tube. It is to be noted that, in this embodiment, the interior vertical reinforcements, the interior horizontal reinforcement, the interior lattice reinforcements, the interior separators, the reinforcement temporary assembly, and the reinforcement assembly in the first embodiment are not used, but the outer peripheral surface of the storage complex 55 and the exterior lattice reinforcement 28 (the plurality of exterior vertical reinforcements 57a and the plurality of exterior horizontal reinforcements 27) are covered with a lattice-shaped reinforcing rebar (not shown) formed by welding reinforcements extending in the vertical and horizontal directions.

[0036]

It is to be noted that reference numeral 19g in FIG. 12 denotes four notched concave portions formed at four

corners of an opposite surface of a surface facing the base plate 18 of both the surfaces of the central reinforcement plate body 19 of the exterior form 56, respectively. A reinforcement plate connecting hole 19h is formed at a center of each of these notched concave portions 19g. Further, when the four central reinforcement plates 19 are closely aligned in the vertical and horizontal directions, the four notched concave portions 19g are combined at the center of these central reinforcement plates 19 to form a connecting plate accommodation concave portion 19i which can accommodate a square plate-shaped connecting plate (not shown). Four reinforcement plate connecting pins (not shown) are protruded on a back side of the connecting plate, and inserting these reinforcement plate connecting pins into the reinforcement plate connecting holes 19h of the four central reinforcement plates 19 respectively connects the four central reinforcement plates 19. Here, the reinforcement plate connecting pins are press-fitted or drove into the reinforcement plate connecting holes 19h and configured so that they cannot be easily removed by vibration or the like.

[0037]

On the other hand, a spindle pipe 68 extending in the vertical direction is provided to pierce through the partition plates 58 and the spacers 66 constituting the outermost layer portion 67 and the interior outer layer portion 69 (FIG. 10 and FIG. 11). Furthermore, a plurality of long holes 68a extending in the longitudinal direction

of the spindle pipe 68 are formed on an outer peripheral surface of the spindle pipe 68 at predetermined intervals to prevent occurrence of air accumulation (FIG. 10).

Moreover, the spindle pipe 68 is provided to extend from the bottom surface to the top surface of the storage tank 50 (FIG. 10 and FIG. 11). It is to be noted that, when the storage tank is relatively small in size and just relatively small strength is required, the spindle pipe may be omitted.

[0038]

The partition plates 58 which are placed on the inner side of the interior outer layer portion 69 and constitute the first horizontal connecting body 61 on the lowermost stage and the third horizontal connecting body 63 on the third stage from the bottom in the first to fourth horizontal connecting bodies 61 to 64 are connected through a long spacer 73 configured to be longer than the spacer 66 and extend in the vertical direction and connecting adaptors 74 (FIG. 11 and FIG. 13). Additionally, the connecting adaptor 74 has a binding member 75 which binds the four partition plates 58 as one in the same plane and a funnel-shaped funnel member 76 which connects this binding member 75 with the long spacer 73. A square plate-shaped bottom plate 77 is laid on a lower surface of the first horizontal connecting body 61 on the lowermost stage, and a square plate-shaped top plate 78 is put on a top surface of the fourth horizontal connecting body 64 on the uppermost stage (FIG. 13). Further, a top surface of the top plate 78 is covered with an impermeable sheet 79.

Consequently, mud water is prevented from entering the storage tank 50.

[0039]

On the other hand, a tip of a rainwater introducing tube 81 is inserted into the storage tank 50 (FIG. 13). A base end of this rainwater introducing tube 81 is connected to a dust removal management pit 82 buried in the ground at a position higher than the storage tank 50, and this dust removal management pit 82 is connected to a side ditch 84 having a substantially U-like cross section through a rainwater inflow tube 83. The dust removal management pit 82 has a first pit 91 connected to the side ditch 84 through the rainwater inflow tube 83 and a second pit 92 provided to be adjacent to the first pit 91. A middle bottom wall 91a having a top surface tilting in a gradually declining direction is provided at the center of the first pit 91 in the vertical direction. Furthermore, at the center of a bottom portion of the first pit 91, an upright tube 91b is erected to pierce through the middle bottom wall 91a, and an upper end of this upright tube 91b is formed to tilt in substantially the same direction as that of the top surface of the middle bottom wall 91a. Moreover, the base end of the rainwater introducing tube 81 is connected to a lower side surface of the upright tube 91b. On the other hand, on adjoining side surfaces of the first pit 91 and the second pit 92, an outflow hole 91c and an inflow hole 92a which lead a small amount of rainwater flowing down on the middle bottom

wall 91a in light rain into the second pit 92 are formed, respectively.

[0040]

An assembling procedure of the thus configured storage tank 50 will now be described. First, the hole 59 having the bottom portion wider than the bottom slab 52 is dug in the ground, and the concrete bottom slab 52 is laid on the bottom portion of this hole 59 (FIG. 13). Then, the plurality of square plate-shaped partition plates 58, the cylindrical spacers 66, the first coupling pieces 71, the second coupling pieces, the spindle pipes 68, and the like are prepared, the storage complex 55 is constructed on the bottom slab 52, and this storage complex 55 is accommodated in the hole 59. In this instance, the outermost layer portion 67 of the storage complex 55 is first constructed on the bottom slab 52, and then the inside of the storage complex 55 is constructed, but the permanent form 53 is constructed simultaneously with this construction of the inside of the storage complex 55.

[0041]

A constructing procedure of the permanent form will now be described with reference to FIG. 10. First, the auxiliary receiving members 72 are inserted into the flow holes 58f of the partition plates 58 constituting the outermost layer portion 67 along the outer face of the outermost layer portion 67. Then, the interior forms 54 on three stages are formed in the square cylinder shape respectively by arranging the plurality of interior plates 54a so that they come into

contact with portions, which form the outer face of the outermost layer portion 67, of the plurality of spacers 66 constituting the outermost layer portion 67 in accordance with each stage between the four-stage partition plates 58. Further, the plurality of exterior vertical reinforcements 57a are extended in the vertical direction so as to be placed on the outer side of the plurality of interior plates 54a, and inserted into the through holes, which are parallel to the outer face of the outermost layer portion 67, of the plurality of partition plates 58 which constitute the outermost layer portion 67 and are arranged at intervals in the vertical direction, then the exterior horizontal reinforcements 27 extending in the horizontal direction and the external vertical reinforcements 57a are crossed, and their intersections are fixed by the binding wires (not shown) to form the exterior lattice reinforcements 28. Subsequently, a water blocking material (not shown) having water swelling properties is arranged on the bottom slab 52 between the interior forms 54 and the exterior forms 56, and then the outer peripheral surface of the storage complex 55 and the exterior lattice reinforcements 28 (the plurality of exterior vertical reinforcements 57a and the plurality of exterior horizontal reinforcements 27) are covered with the lattice-shaped reinforcing rebar (not shown).

[0042]

Furthermore, the base plates 18 on the first stage and the second stage of the exterior forms 56 are assembled on

the bottom slab 52, these base plates 18 are coupled using the central reinforcement plates 19, the plurality of end reinforcement plates 21 are placed on lower edges and both-side edges of the plurality of central reinforcement plates 19 closely aligned in the horizontal direction, the adjoining base plates 18 are coupled using these end reinforcement plates 21, and the exterior forms 56 abutting on each other at a right angle are connected through the exterior corner portion connecting plate 22, thereby forming the exterior forms 56 into a square frame shape at a predetermined interval from the exterior vertical reinforcements 57a (FIG. 11). In this instance, the reinforcing rebars are placed between the external vertical reinforcements 57a and the exterior forms 56. Then, one end of each exterior separator 24 is locked on each exterior horizontal reinforcement 27, the other end of the same is locked in each locking hole 18i of the base plates 18 on the first stage, one end of another exterior separator 24 is locked on each exterior horizontal reinforcement 27, and the other end of the same is locked in each locking hole 18i of the base plates 18 on the second stage (FIG. 10).

[0043]

Furthermore, the base plates 18 on the third state are stacked on the base plates 18 on the second stage, these base substrates 18 are coupled through the central reinforcement plates 19, the plurality of end reinforcement plates 21 are placed on the upper edges and both-side edges of the plurality

of central reinforcement plates 19 closely aligned in the horizontal direction, the adjoining base plates 18 are coupled using these end reinforcement plates 21, and the exterior forms 56, 56 abutting on each other at a right angle are connected through the exterior corner portion connecting plate 22. Moreover, one end of each exterior separator 24 is locked on each exterior horizontal reinforcement 27, and the other end of the same is locked in each locking hole 18i of the base plates 18 on the third stage. Consequently, the exterior forms 56 having the self-standing properties and robustness can be easily assembled. Consequently, as compared with a case where steel nettings or bricks are used as the exterior forms, the assembling work of the exterior forms 56 can be greatly shortened.

[0044]

Then, the fresh concrete is poured and hardened between the interior forms 54 and the exterior forms 56 to form the sidewall 51 (FIG. 10, FIG. 11, and FIG. 13). In this instance, since the auxiliary receiving members 72 as well as the plurality of spacers 66 constituting the outermost layer portion 67 receive the interior forms 54, the spacers 66 and the auxiliary receiving members 72 receive a pressure of the fresh concrete acting on the interior forms 54. Consequently, the storage complex 55 can be assuredly prevented from deforming at the time of casting the fresh concrete between the interior forms 54 and the exterior forms 56. Additionally, even if a large amount of the fresh concrete

is poured between the interior forms 54 and the exterior forms 56 at a time, the exterior vertical reinforcements 57a hold the exterior forms 56 through the exterior separators 24, the interior forms 54 are received by the auxiliary receiving members 72 together with the plurality of spacers 66 constituting the outermost layer portion 67, and hence the concrete sidewall 51 having a predetermined shape can be formed without deforming the exterior forms 56 and the interior forms 54. Operations and effects other than those described above are substantially the same as the operations and the effects of the first embodiment, thus omitting a repeated description.

[0045]

<Third Embodiment>

FIG. 14 shows a third embodiment according to the present invention. In FIG. 14, reference numerals equal to those in FIG. 1 to FIG. 9 denote the same parts. In this embodiment, a hole is shallowly dug, a bottom slab is laid on a bottom portion of this hole, and a storage tank is installed in such a manner that a lower portion thereof is buried in the ground and an upper portion thereof is protruded on the ground. Further, decorative plates 34 are mounted on surfaces of central reinforcement plates 19 of an external form 106 of a permanent form 103 forming a sidewall of the storage tank protruded on the ground. A pattern 34b constituted of Mount Fuji and the sun is raised on a surface of each of the decorative plates 34. Parts other than those

described above are constituted in the same manner as that in the second embodiment.

[0046]

In the permanent form 103 of the thus configured storage tank, since the decorative plates 34 having the pattern 34b constituted of Mount Fuji and the sun raised thereon are mounted on the surfaces of the central reinforcement plates 19 protruded on the ground, the appearance of the surfaces of the portions protruded on the ground of the storage tank can be improved. Operations and effects other than those described above are substantially the same as the operations and the effects of the second embodiment, thus omitting a repeated description.

[0047]

It is to be noted that, in the first embodiment, the square frame-shaped underground beam is erected on the concrete square plate-shaped bottom slab laid on the bottom portion of the hold dug in the ground, but a triangular frame-shaped, a pentagonal frame-shaped, any other polygonal frame-shaped, or a straight-line underground beam may be erected on a triangular plate-shaped, polygonal plate-shaped, or any other polygonal bottom slab. Furthermore, in the first and third embodiment, the pattern constituted of Mount Fuji and the sun is raised on the surface of each decorative plate, a pattern of pigeons or cherry blossoms, a manufacturer's logo, or any other pattern may be raised or indented on the surface of each decorative plate. Moreover,

the bottom slab is laid on the bottom portion of the hole and the entire storage tank is buried in the ground in the second embodiment, the hole is shallowly dug, the bottom slab is laid on the bottom portion of this hole and the storage tank is installed in such a manner that the lower portion thereof is buried in the ground and the upper portion thereof protruded on the ground in the third embodiment, but the bottom slab may be laid on the ground, and the entire storage tank may be installed on the ground. In this case, mounting the decorative plates on the surfaces of the central reinforcement plates of the exterior form enables improving the appearance of the surface of the storage tank.

[0048]

Additionally, the horizontal connecting bodies are provided on the three stages in the second embodiment, but the horizontal connecting bodies may be provided on two stages or four or more stages. Further, in the second embodiment, the partition plates on the inner side of the interior outer layer portion are arranged at an interval of one stage in the vertical direction, but the interior outer layer portion may be eliminated when an earth pressure from the top surface of the storage tank is relatively small. That is, the partition plates on the inner side of the outermost layer portion may be arranged at an interval of one stage in the vertical direction. Furthermore, the concrete bottom slab is laid and then the concrete sidewall is provided on the bottom slab in the second embodiment, but the concrete

bottom slab and sidewall may be simultaneously formed. Specifically, the reinforcements welded in a lattice pattern may be formed into a bowl-like shape to fabricate a bowl-shaped reinforcement, the plurality of bowl-shaped reinforcements may be aligned and placed on a bottom portion of a hole in an inverted manner, a first-stage horizontal connecting body and an outermost layer portion of a storage complex may be assembled on these members, and the fresh concrete may be poured into a portion which becomes a bottom slab (a portion including the plurality of bowl-shaped reinforcements aligned on the bottom portion of the hole) and a portion which becomes a sidewall (the inside of a sidewall forming member) from a plurality of positions in a state where the sidewall forming member has been assembled to surround the plurality of bowl-shaped reinforcements, thereby simultaneously forming the bottom slab and the sidewall which are made of concrete.

REFERENCE SIGNS LIST

[0049]

- 11 underground beam (sidewall)
- 12, 52 bottom slab
- 13, 53, 103 permanent form
- 14 interior form
- 16, 56, 106 exterior form
- 17, 57 vertical reinforcement
- 18 base plate

19	central reinforcement plate
21	end reinforcement plate
34	decorative plate
34b	pattern
50	storage tank
51	sidewall
55	storage complex

CLAIMS

1. A permanent form for forming concrete structures, which is provided to form a concrete structure constituted of a concrete sidewall erected on a concrete bottom slab laid on a bottom portion of a hole dug in the ground or on the ground, and remains on a surface of the sidewall, comprising:

an interior form forming an inner face of the sidewall;
an exterior form forming an outer face of the sidewall, and
a plurality of vertical reinforcements which are arranged between the interior form and the exterior form and hold the exterior form or both the exterior form and the interior form,

wherein the exterior form or both the exterior form and the interior form have: a plurality of base plates which are formed into a square plate shape with the use of plastic and closely aligned in the vertical and horizontal directions;
a plurality of central reinforcement plates which are formed into a square plate shape substantially equal to that of the base plates in size with the use of plastic, couple four adjacent base plates, and closely aligned in the vertical and horizontal directions; and a plurality of end reinforcement plates which are formed into a rectangular plate shape with the use of plastic, placed on outer edges of the plurality of central reinforcement plates closely aligned in the vertical and horizontal directions, and aligned in a square frame shape while coupling adjacent base plates.

2. The permanent form for forming concrete structures according to claim 1, wherein plastic decorative plates are mounted on surfaces of the plurality of central reinforcement plates respectively, and a pattern is raised or indented on a surface of each of the decorative plates.

3. The permanent form for forming concrete structures according to claim 1 or 2, wherein the sidewall is a concrete underground beam which is buried in the ground and provided on the bottom slab to support a building, an outer face of the underground beam is formed of the exterior form, and an inner face of the underground beam is formed of the interior form.

4. The permanent form for forming concrete structures according to claim 1 or 2, wherein the sidewall is a concrete square cylindrical sidewall provided on the bottom slab to surround a rectangular parallelepiped storage complex for forming a storage tank, and an outer face of the sidewall is formed of the exterior form.