FLOATING STRUCTURE AND SYSTEM

FIELD OF INVENTION

The present invention relates to a floating structure and system arranged to support at least a plant and/or an individual.

BACKGROUND TO THE INVENTION

The following discussion of the background to the invention is intended to facilitate an understanding of the present invention. However, it should be appreciated that the discussion is not an acknowledgment or admission that any of the material referred to was published, known or part of the common general knowledge in any jurisdiction as at the priority date of the application.

Urban developments that occur close to existing water bodies often give rise to adverse environmental effects such as leaching of nutrients from soils rich in nitrogen and phosphorus. The leaching process typically results in eutrophication, which generally promotes excessive plant growth and decay, supporting algae and plankton over other plants. With an enhanced growth of algae and plankton, the normal functioning of the ecosystem is disrupted causing several problems such as severe reduction in water quality and hypoxia. Although eutrophication is commonly caused by human activities, it can also occur naturally especially in lakes in situations where nutrients accumulate due to climate change, geology and other external influences.

To address the water pollution problems described above, there are commercially available floating wetlands constructed using aquatic plants suspended in floating rafts which mimic natural wetlands. Natural wetlands are known to improve water quality as the wetland plants process excess nutrients present in water bodies, intercept pollutants, trap sediments and reduce suspended solids in the water. Similarly, man-made floating wetlands improve water quality by acting as a filtration system where excess nutrients are processed and particles, such as soil, washed down from embankments are trapped and retained from polluting the water downstream. Apart from improving water quality, floating wetlands also help to increase habitat biodiversity.

A typical floating wetlands system is constructed from matrix sheets derived from non-woven fibres processed from recycled PET plastic bonded together with marine foam, or is formed by tying polyurethane (PU) foam tubes and fibre together. Emergent plants are then planted in the system. However, such systems restrict the configuration of various shapes and sizes of the floating wetlands, and can only be used for growing plants. Furthermore, some of the better designed systems are expensive to construct and install.

TW 201010597 discloses a floating planting raft which includes a polygonal floating frame where the inside is hollow. The outer periphery has several lugs to join adjacent planting rafts, and different shapes and areas can be then assembled. Planting pots are then disposed in the area surrounded by the floating frame. Although such a system allows for the configuration of various shapes and sizes of the floating wetlands, the lugs are connected by a bolt and nut system

which makes it difficult and cumbersome to connect or dismantle a floating raft to/from adjacent floating rafts. Furthermore, such a system can support the weight of plants only which makes it difficult for an individual to carry out maintenance work on the floating rafts.

Therefore, the present invention seeks to provide a floating structure and system arranged to support at least a plant and/or an individual that overcomes, or at least alleviates, the above-mentioned problems.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the invention, there is provided a floating structure arranged to support at least a plant and/or an individual, said structure having an upper surface and one or more sides extending therefrom, the upper surface having one or more apertures and said one or more sides having male and female connectors, with at least one male connector being positioned so as to extend from the side of the structure at a first location and at least one female connector being positioned at a second location on the side or a different side of the structure, said male and female connectors being releasably connectable to corresponding connectors on an adjacent floating structure thereby enabling a plurality of said structures to be connected to one another.

Preferably, the floating structure is polygonal.

Preferably, said male and female connectors alternate in height along the side of the structure.

Preferably, said male and female connectors alternate in relation to one another on multiple sides of the structure.

Preferably, the upper surface has at least one connector to receive one or more platforms to support an individual on the floating structure.

Preferably, the connector is a rim into which the one or more platforms can be inserted.

Preferably, the upper surface and said male and female connectors are configured to receive securing means to secure the connection between the floating structure and said adjacent floating structure.

Preferably, said securing means is in the form of a pin which passes through the upper surface, said male and female connectors and said corresponding connectors on said adjacent floating structure to secure the connection between the floating structure and said adjacent floating structure.

Preferably, said one or more apertures is a through hole.

Preferably, said through hole is adapted to receive a perforated member to support at least a plant and plant media received in said through hole.

Preferably, the floating structure is filled with polyurethane foam.

Preferably, the floating structure is hexagonal.

Preferably, the floating structure further comprises connecting means for connecting to an anchor.

In accordance with a second aspect of the invention, there is provided a floating system comprising:

a plurality of floating structures according to the first aspect of the invention connected to one another for supporting at least a plant and/or an individual.

Preferably, the floating system comprises twelve floating structures connected to form a configuration of two structures by six structures.

Preferably, the floating system further comprises an anchor for anchoring the system.

BRIEF DESCRIPTION OF DRAWINGS

The present invention will now be described, by way of illustrative example only, with reference to the accompanying drawings, of which:

FIG. 1 is a perspective view of a floating structure arranged to support at least a plant and/or an individual in accordance with a first aspect of an embodiment of the present invention;

FIG. 2A is a perspective view of a screw cap and a screw thread for connecting the floating structure of FIG. 1 to an anchor;

FIG. 2B is a plan view of the floating structure when connected to an anchor by means of the screw cap and the screw thread of FIG. 2A;

FIG. 2C is a side view of the floating structure when connected to the anchor of FIG. 2B;

FIG. 3 is a perspective view of the floating structure of FIG. 1 being connected to three other floating structures to form a floating system in accordance with a second aspect of an embodiment of the present invention;

FIG. 4 is an illustration of the floating system of FIG. 3 which comprises twelve floating structures connected to form a configuration of two structures by six structures according to another embodiment of the present invention;

FIG. 5 shows the floating system with the two structures by six structures configuration of FIG. 4 subjected to different inclining angles , θ, where $\theta = 0°$, $\theta = 10°$, $\theta = 20°$, $\theta = 30°$, $\theta = 40°$ and $\theta = 50°$; and

FIG. 6 shows a plot of restoring moment (kg-m) against inclining angle (θ), of the six different inclining angles of the floating system of FIG. 5.

DETAILED DESCRIPTION

FIG. 1 shows an embodiment of a floating structure 10 arranged to support at least a plant and/or an individual in accordance with a first aspect of the invention. The floating structure 10 is in the form of a polygonal module, which in this preferred embodiment is in the form of a hexagonal module 12 which comprises six sides 14, 16, 18, 20, 22, 24, an upper surface 26 and a lower surface 28. Each of the six sides 14, 16, 18, 20, 22, 24 extends from the upper surface 26 to the lower surface 28.

Advantageously, the module 12 is hexagonal in shape as this shape provides better contact between the module 12 and other modules when they are connected together. The hexagonal shape also strengthens the connection between the module 12 and other modules when they are connected together. Advantageously, the module 12 is made from high-density polyethylene (HDPE) as HDPE is durable and will not degenerate when it comes into contact with water even after several decades. It would be understood that besides HDPE, the module 12 can also be made of other materials which have the above-mentioned advantage. An example of a material that can be used is polypropylene.

The module 12 also comprises a first set of male connectors 30, a second set of male connectors 32, a first set of female connectors 34, and a second set of female connectors 36. The floating structure 10 can also include at least one platform 38 and a perforated member, typically in the form of a mesh 40. The mesh 40 can be made of stainless steel or HDPE or the like.

The upper surface 26 of the module 12 has at least one aperture and in this case a through hole or channel 42 which extends between the upper surface 26 and the lower surface 28, and is for receiving and housing at least a plant (not shown). The upper surface 26 also has at least one connector, which in this preferred embodiment is in the form of a rim 44, to receive the platform 38 to support an individual on the floating structure 10.

The channel 42 has a first end 46 and a second end 48, and is for receiving and housing at least a plant (not shown). The first end 46 of the channel 42 extends from the rim 44 of the upper surface 26 of the module 12 and the second end 48 of the channel 42 extends from the lower surface 28 of the module 12. The channel 42 tapers from the first end 46 towards the second end 48. As such, the diameter of the first end 46 of the channel 42 is greater than the diameter of the second end 48 of the channel 42.

To cover the channel 42, the platform 38 can be inserted into the rim 44. Particularly, the peripheral portion of the platform 38 is received in the rim 44 when the platform 38 is placed over the first end 46 of the channel 42. Advantageously, the rim 44 prevents the platform 38 from sliding into the channel 42. The platform 38 is for covering the first end 46 when no plants are placed in the channel 42 so as to prevent an individual from falling or slipping into the channel 42. Furthermore, when the platform 38 is inserted into the rim 44 and covers the first end 46 of the channel 42, the platform 38 forms an extension of the upper surface 26 for supporting at least an individual. Advantageously, the platform 38 is made from HDPE which makes the platform 38 durable. It would be understood that

besides HDPE, the platform 38 can also be made of other materials which have the above-mentioned advantage. An example of a material that can be used to make the platform 38 is polypropylene.

The second end 48 of the channel 42 is shaped for receiving the mesh 40. Similar to the upper surface 26, the second end 48 comprises a rim 50 for receiving a portion of the mesh 40. Advantageously, the peripheral portion of the mesh 40 is received in the rim 50 when the mesh 40 is placed into the channel 42 towards the second end 48, which prevents the mesh 40 from sliding out of the channel 42 from the second end 48. The mesh 40 is for supporting at least a plant and plant media received in the channel 42. Particularly, when the mesh 40 is received in the rim 50 and plants are placed in the channel 42, the stems and leaves of the plants are held in the channel 42 whereas the roots of the plants are allowed to pass through the holes of the mesh 40 emerging from the second end 48 of the channel 42. The mesh 40 is also for holding plant media in the channel 42, which is required to support plant growth when plants are placed in the channel 42.

The first and second sets of male connectors 30, 32 and the first and second sets of female connectors 34, 36 are releasably connectable to corresponding connectors on the module of an adjacent floating structure thereby enabling a plurality of floating structures to be connected to one another. Each of the male connectors 30, 32 is in the form of a protrusion and is positioned so as to extend from a side 14, 16, 18, 20, 22 or 24 of the module 12 at a first location, and each of the female connectors 34, 36 is in the form of a receptacle and is positioned at a second location on a side 14, 16, 18, 20, 22 or 24 of the module 12. The male

connectors 30, 32 are inserted to corresponding female connectors on the modules of adjacent floating structures while the female connectors 34, 36 are received in corresponding male connectors on the modules of the adjacent floating structures thereby enabling a plurality of the floating structures to be connected to one another.

Particularly, the first set of male connectors 30 comprises three male connectors in which one male connector 30 is positioned at the side 14 of the module 12, a second male connector 30 is positioned at the side 18 of the module 12, and a third male connector 30 is positioned at the side 22 of the module 12. The first set of female connectors 34 similarly comprises three female connectors in which one female connector 34 is positioned at the side 16 of the module 12, a second female connector 34 is positioned at the side 20 of the module 12, and a third female connector 34 is positioned at the side 24 of the module 12. In other words, the first set of male connectors 30 and the first set of female connectors 34 alternate in relation to one another on the sides 14, 16, 18, 20, 22, 24 of the module 12.

Advantageously, the width of each of the female connectors 34 is wider as compared to the width of each of the male connectors 30 for ease of connection when the module 12 is connected to other modules. Furthermore, each of the male connectors 30 tapers in a direction away from the respective side 14, 18 or 22 of the module 12. Advantageously, this allows for some degree of movement between the floating structures when they are connected to one another.

The second set of male connectors 32 comprises three male connectors in which one male connector 32 is positioned adjacent the female connector 34 at the side 16 of the module 12, a second male connector 32 is positioned adjacent the female connector 34 at the side 20 of the module 12, and a third male connector 32 is positioned adjacent the female connector 34 at the side 24 of the module 12.

The second set of female connectors 36 similarly comprise three female connectors in which one female connector 36 is positioned adjacent the male connector 30 at the side 14 of the module 12, a second female connector 36 is positioned adjacent the male connector 30 at the side 18 of the module 12, and a third female connector 36 is positioned adjacent the male connector 30 at the side 22 of the module 12. In other words, the second set of male connectors 32 and the second set of female connectors 36 alternate in relation to one another on the sides 14, 16, 18, 20, 22, 24 of the module 12.

Additionally, the male connectors 30, 32 and the female connectors 34, 36 alternate in height along the sides 14, 16, 18, 20, 22, 24 of the module 12. Particularly, on the side 14, the male connector 30 is positioned towards the upper surface 26 of the module 12, and on the adjacent side 16, the male connector 32 is positioned towards the lower surface 28 of the module 12. On the side 18, which is the side adjacent to the side 16, the male connector 30 is positioned towards the upper surface 26, and on the side 20, the male connector 32 is positioned towards the lower surface 28 of the module 12, and so on. On the other hand, the female connector 36 is positioned towards the lower surface 28 on the side 14 of the module 12, and the female connector 34 is positioned towards

the upper surface 26 on the side 16 of the module 12. On the side 18, the female connector 36 is positioned towards the lower surface 28 of the module, and on the side 20, the female connector 34 is positioned towards the upper surface 26 of the module 12, and so on. In other words, there are both male and female connectors 30, 36 or 32, 34, each being positioned either towards the upper surface 26 or towards the lower surface 28, on the respective sides 14, 16, 18, 20, 22, 24 of the module 12.

Put differently, with the first and second sets of male connectors 30, 32 and the first and second sets of female connectors 34, 36 arranged in the alternate fashion as described above, each of the six sides 14, 16, 18, 20, 22, 24 of the module 12 has either one male connector of the first set of male connectors 30 and one female connector of the second set of female connectors 36, or one male connector of the second set of male connectors 32 and one female connector of the first set of female connectors 34. Specifically, each of the sides 14, 18, 22 of the module 12 has one male connector 30 positioned towards the upper surface 26 and one female connector 36 positioned towards the lower surface 28, while each of the sides 16, 20, 24 of the module 12 has one male connector 32 positioned towards the lower surface 28 and one female connector 34 positioned towards the upper surface 26.

Each of the male connectors of the first set of male connectors 30 and each of the female connectors of the first set of female connectors 34 is for connecting laterally to corresponding connectors on the modules of adjacent floating structures. Advantageously, the second set of male connectors 32 and the

second set of female connectors 36 are for providing additional points of connection between the module 12 and other modules that are laterally connected to the module 12, which strengthen the connection there between.

The floating structure 10 further comprises securing means, which in this preferred embodiment is in the form of a pin 52, for securing the connection between the module 12 and other modules of adjacent floating structures. The upper surface 26, each of the male connectors 30, 32, each of the female connectors 34, 36 and corresponding connectors on the modules of adjacent floating structures are configured to receive the pin 52. Each of the male connectors 30, 32 has a through hole for receiving the pin 52 when the module 12 is connected to other modules. Similarly, each of the female connectors 34, 36 has a through hole for receiving the pin 52. The corresponding connectors of adjacent floating structures likewise have through holes for receiving the pin 52.

The upper surface 26 comprises six through holes for receiving the pin 52, each of which corresponds to the hole of one of the female connectors 34, 36. The hole of each of the male connectors 30, 32 also corresponds with one of the holes of the upper surface and the hole of one of the female connectors of other modules when the module 12 is connected to such other modules. In this way, each of the holes of the upper surface 26 is aligned with the hole of one of the male connectors of other modules and with the hole of one of the female connectors 34, 36 when the module 12 is connected to such other modules, thereby allowing the pin 52 to be received there through for securing the connection between the module 12 and

such other modules. Furthermore, the lower surface 28 can have a through hole for receiving the pin 52 such that the pin 52 passes through the lower surface 28.

In the event where removal or disconnection of one other module of an adjacent floating structure that is connected to the module 12 is desired, the respective pin 52 can be easily removed from the respective hole of the upper surface 26, the hole of the corresponding female connector 34 or 36, and the hole of the corresponding male connector of the other module. Similarly, the respective pin of the other module can be easily removed from the respective hole of its upper surface, the hole of its corresponding female connector and the hole of the corresponding male connector 30 or 32 of the module 12 so as to release the secured connection between the module 12 and the one other module. Once the respective pins of the module 12 and the one other module are removed, the one other module can be easily disconnected from the module 12. Similarly, if there were other modules connected to the module 12 and it is desired to remove those other modules, the respective pins can be removed and those other modules can be easily disconnected from the module 12 in the manner as described above.

The upper surface 26 has an anti-slip surface, for example a mesh or a dotted-matt finish. Advantageously, such a surface is for preventing an individual from slipping when standing or walking on the floating structure 10. Similarly, the platform 38 can also have an anti-slip surface, for example a mesh or a dotted-matt finish, to prevent an individual from slipping when standing or walking on the floating structure 10.

As the module 12 has six sides 14, 16, 18, 20, 22, 24, six other modules are connectable to the module 12. As such, the module 12 requires up to six pins 52 for securing the connection between the module 12 and other modules of adjacent floating structures. The pin 52 has a diameter of about 0.022 m. The pin 52 having such a diameter is advantageous because the cost of manufacturing the floating structure 10 and the weight of the floating structure 10 are reduced without compromising the strength and serviceability of the pin 52. The pin 52 can be made of stainless steel, HDPE, polypropylene or the like. It would be understood that the pin 52 can be made of any other materials besides the examples stated above, as long as the pin 52 is able to perform the function of securing the connection between the module 12 and other modules of adjacent floating structures.

The module 12 is filled with polyurethane (PU) foam (not shown) for supporting the weight of plants and individuals on the module 12. The PU foam has a density of about 40 kg/m^3. The PU foam is also for ensuring that the module 12 is water tight. In the event where the module 12 is placed in water and is ruptured or punctured, the PU foam will prevent water from entering the module 12 and will keep the module 12 afloat.

Preferably, the floating structure 10 is configured to support a load of about 114 kg. In order for the floating structure 10 to support such a load, the module 12 has the dimensions as described hereinafter. The length of each of the six sides 14, 16, 18, 20, 22, 24 of the module 12 is about 0.5 m. As such, the module 12 has a width of about 1.0 m, corner to corner. The height or depth of the module 12 is

about 0.41 m. Advantageously, the module 12 having a height or depth of about 0.41 m provides for much greater flexural rigidity as compared to a module with a lesser height or depth.

The diameter of the first end 46 of the channel 42 is about 0.5 m and the diameter of the second end 48 of the channel 42 is about 0.3 m. The module 12 has a plan area of about 0.45 m^2, excluding the area of the rim 44 and the first end 46 of the channel 42. In other words, the upper surface 26 has a surface area of about 0.45 m^2. With the platform 38 received in the rim 44, the total plan area of the module 12 is about 0.65 m^2.

Each of the male connectors 30, 32 protrudes about 0.1 m from the respective sides 14, 16, 18, 20, 22, 24 of the module 12, and tapers in a direction away from the respective sides 14, 16, 18, 20, 22, 24 of the module 12. Each of the male connectors 30, 32 tapers from a width of about 0.15 m and thickness of about 0.1 m to a width of about 0.12 m and thickness of about 0.07m.

The receptacle of each of the female connectors 34, 36 extends about 0.1m from the respective sides 14, 16, 18, 20, 22, 24 of the module 12 towards the centre of the module 12. Each of the female connectors 34, 36 tapers in a direction towards the centre of the module 12 from a width of about 0.4 m to a width of about 0.36 m and has a uniform thickness of about 0.1 m.

The dead weight of the module 12 having the above-mentioned dimensions and filled with PU foam is about 25.53 kg. The module 12 can support a load of about

114 kg, of which about 15 kg is the load for plants and plant media and the remaining about 99 kg is the load for individual(s) and/or equipment or machinery, such as those required for maintenance of the module 12, for connecting to or dismantling from other corresponding modules, or for measuring the water quality. It would be understood that the module 12 is able to support any type of load, and is not restricted to supporting only the above-mentioned examples of plants, plant media, individual(s), equipment and machinery, so long as the total load does not exceed 114 kg. When the module 12 is placed in water and is fully loaded, the freeboard of the module 12 is about 0.15 m.

Advantageously, the male connectors 30, 32 and the female connectors 34, 36 are specifically designed to allow for greater degree of freedom in sliding, connecting, dismantling and reconnecting, when other modules are connected to or removed from the module 12.

The floating structure 10 can further comprise connecting means, which in this preferred embodiment is in the form of a screw cap 54 and a screw thread 56, for connecting the module 12 to an anchor 58 as shown in FIGS. 2A to 2C. The module 12 is configured to receive the screw cap 54 and the screw thread 56. Particularly, the module 12 comprises a through hole (not shown) that goes through the upper surface 26 and the lower surface 28.

The screw thread 56 has a loop 60 at one end for connecting to the anchor 58 by means of a cable 62. The screw thread 56 is inserted into the hole of the module 12 from the lower surface 28, with the loop 60 at the side of the lower surface 28

after insertion, as shown in FIG. 2C. The other end of the screw thread 56 emerges at the upper surface 26 of the module 12 after insertion and the screw cap 54 is used to fasten the screw thread 56 to the module 12. In this way, the screw cap 54 and the screw thread 56 are securely fastened to the module 12. The cable 62 is then used to connect the module 12 to the anchor 58 via the loop 60 of the screw thread 56. The cable 62 can be in the form of a taut catenary.

The anchor 58 is for anchoring the floating structure 10 such that the floating structure 10 is fixed at a desired location when placed in water and not drift to another location. The anchor 58 can be in the form of a concrete sinker that sinks and rests on the bed of a water body.

In another embodiment (not shown) of the floating structure 10, instead of having both the first and second sets of male connectors 30, 32 and both the first and second sets of female connectors 34, 36, the module 12 can have only the first set of male connectors 30 and the first set of female connectors 34. In such an embodiment, the male connectors 30 and the female connectors 34 similarly alternate in relation to one another on the sides 14, 16, 18, 20, 22, 24 of the module 12 of the floating structure 10, as described above. That is to say, each of the sides 14, 18, 22 of the module 12 has one male connector 30 extending therefrom, while each of the sides 16, 20, 24 of the module 12 has one female connector 34.

In yet another embodiment (not shown) of the floating structure 10, instead of having the male connectors 30, 32 and the female connectors 34, 36 alternate in

height along the respective sides 14, 16, 18, 20, 22, 24 of the module 12, each of the sides 14, 16, 18, 20, 22 or 24 can have either two male connectors 30, 32 or two female connectors 34, 36. In such an embodiment, the male connector 32 is positioned at the location of the female connector 36 such that the male connectors 30, 32 are positioned on one side, and the female connector 36 is positioned at the location of the male connector 32 such that the female connectors 34, 36 are positioned on one side.

Furthermore, the sides having two male connectors 30, 32 can alternate with the sides having two female connectors 34, 36. That is to say, if each of the sides 14, 18, 22 has two male connectors 30, 32, then each of the sides 16, 20, 24 has two female connectors 34, 36. Alternatively, a side having two male connectors 30, 32 can be adjacent to another side having two male connectors 30, 32, and a side having two female connectors 34, 36 can be adjacent to another side having two female connectors 34, 36. For example, each of the sides 14, 16, 18 can have two male connectors 30, 32 and each of the sides 20, 22, 24 can have two female connectors 34, 36.

Alternatively, the module 12 can have a side having two male connectors 30, 32 being adjacent to a side also having two male connectors 30, 32 and a side having two female connectors 34, 36, and a side having two female connectors 34, 36 being adjacent to a side also having two female connectors 34, 36 and a side having two male connectors 30, 32. For example, each of the sides 14, 16 can have two male connectors 30, 32 and each of the sides 22, 24 can have two

female connectors 34, 36 with the side 18 having two female connectors 34, 36 and the side 20 having two male connectors 30, 32.

In yet another embodiment (not shown) of the floating structure 10, instead of the module 12 being hexagonal which has the six sides 14, 16, 18, 20, 22, 24, the module 12 can be circular in shape. In such an embodiment, the module 12 has one side that extends from the upper surface 26 to the lower surface 28, and each of the male connectors 30, 32 and each of the female connectors 34, 36 can be positioned at different locations on the one side of the circular module 12. The male and female connectors 30, 32, 34, 36 can alternate in relation to one another along the circumference or the horizontal plane of the one side of the circular module 12. The male and female connectors 30, 32, 34, 36 can also alternate in height along the one side of the circular module 12 or the vertical plane of the circular module 12. Alternatively, the module 12 can also be elliptical in shape.

FIG. 3 shows an embodiment of the floating structure 10 being connected to three other floating structures to form a floating system 100 in accordance with a second aspect of the invention. The system 100 comprises the floating structure 10, a second floating structure 200, a third floating structure 300 and a fourth floating structure 400. The floating structure 10 is being connected to the second floating structure 200, the second floating structure 200 is being connected to the third floating structure 300, and the fourth floating structure 400 is being connected to the floating structure 10 and the second and third floating structures 200, 300.

Each of the second, third and fourth floating structures 200, 300, 400 is analogous to the floating structure 10. In other words, each of the second, third and fourth floating structures 200, 300, 400 likewise comprises a hexagonal module with six sides, in which each of the six sides extends from the upper surface to the lower surface. The hexagonal module similarly comprises a first and second set of male connectors, and a first and second set of female connectors. The hexagonal module also includes at least one platform and a perforated member, typically in the form of a mesh. The mesh can be made of stainless steel or HDPE or the like.

The upper surface of the hexagonal module similarly has a through hole or channel which extends between the upper surface and the lower surface for receiving and housing at least a plant. The upper surface also has at least one connector such as in the form of a rim to receive the platform to support an individual on the module.

Each of the second, third and fourth floating structures 200, 300, 400 similarly further comprises securing means such as in the form of a pin for securing the connection between the module and other modules of adjacent floating structures, and connecting means such as in the form of a screw cap and screw thread for connecting the module to an anchor.

The hexagonal module of each of the second, third and fourth floating structures 200, 300, 400 is similarly filled with PU foam which has a density of about 40 kg/m^3, and is configured to support a load of about 114 kg. Likewise, the

hexagonal module of each of the second, third and fourth floating structures 200, 300, 400 has dimensions similar to the floating structure 10.

The floating system 100 further comprises at least an anchor (not shown) connectable to one or more of the modules by means of the screw cap and screw thread for anchoring the floating system 100, such that the floating system 100 is fixed at a desired location when placed in water.

Preferably, the floating system 100 is configured to comprise twelve floating structures connected to form a configuration 500 of two structures by six structures as shown in FIG. 4. This configuration is advantageous because this is the smallest configuration of structures connected together to be deemed as stable in accordance with the Norway classification society Det Norske Veritas (DNV). According to the Norway classification society DNV, the angle of vanishing stability θ_v should be greater than 40° in a stability check to ensure that a system is stable.

The configuration 500 is subjected to the DNV stability check analysis. FIG. 5 shows the configuration 500 under different inclining angles, θ, where θ = 0°, θ = 10°, θ = 20°, θ = 30°, θ = 40° and θ = 50°, and FIG. 6 shows a plot of restoring moment (kg-m) against inclining angle (θ), of the six different inclining angles mentioned above.

The greater the restoring moment, the greater the ability a floating system can return to its upright position. Based on the plot shown in FIG. 6, it can be seen that the floating system 100 with the above-mentioned configuration 500 will lose

its ability to return to an upright position at an inclining angle greater than 50°. This means that the configuration has an angle of vanishing stability of θ_v = 50°. This satisfies the DNV requirement that the angle of vanishing stability θ_v be greater than 40° for a system to be considered as stable. Hence, a floating system with the configuration 500 is deemed stable.

Various modifications will be apparent to those skilled in the art. For example, instead of the floating structure 10 being in the form of a hexagonal module 12, the floating structure can be in other polygonal forms such as in the form of a triangle, a square, a pentagon, a heptagon, an octagon and so on.

Instead of each of the first and second sets of male connectors 30, 32 comprising three male connectors, it can also comprise less than or more than three male connectors. Similarly, instead of each of the first and second sets of female connectors 34, 36 comprising three female connectors, it can also comprise less than or more than three female connectors.

The diameter of the first end 46 of the channel 42 can be the same as the diameter of the second end 48 of the channel 42. The size of the channel 42 can also be adjusted or modified depending on the size and number of plants to be received and housed in the channel 42. Furthermore, the module 12 can define more than one channel for receiving and housing plants. For example, the module 12 can define three separate channels each having a narrower diameter as compared to the channel 42 instead of having just one channel 42.

The channel 42 can also include nutrient containers for slow release of nutrient or even a chemical to counteract saline in salt water in the event where the floating structure 10 is placed on a water body that contains salt water which may not be suitable for supporting the growth of all kinds of plants.

Instead of the channel 42 being a through hole, the channel 42 can also be a blind hole in which the channel 42 does not extend completely though the lower surface 28 of the module 12. Such a configuration is advantageous, such as when the floating structure 10 is placed on a water body that contains salt water which may not suitable for supporting the growth of all kinds of plants. This is because the plants can be contained in the channel 42 without having the roots exposed to the salt water. Such a channel 42 can also include a mesh part way along the channel 42, for example, for plants with roots that do not go as deep.

Instead of the module 12 being filled with PU foam, the module 12 can also be filled with just air alone and the module 12 would still be able to support a load of about 114 kg. However, if the module 12 that is filled with air is ruptured or punctured by accident when in water, the module 12 is not water tight and will not be able to prevent water from entering the module 12. Styrofoam can also be used instead of PU foam, which also enables the module 12 to be water tight. It would be understood that besides PU foam and Styrofoam, other materials of the like which are able to provide buoyancy to the module 12 can also be used to fill the module 12.

The floating structure 10 and floating system 100 can also be installed with demountable railings, so that individuals can hold on to such railings when standing or walking on the floating structure 10 or floating system 100. Furthermore, the securing means can be in the form of a railing or handle bar instead of the pin 52 as described above. Such securing means would be able to function as both securing the connection between the module 12 and other modules and as a railing or handle bar for individuals to hold on to.

It would be appreciated that the floating system 100 can be used for various purposes and not limited to supporting plants and individuals. This is because the floating system 100 is made up of floating structures that are modular and connectable to one another to form the desired floating system 100. This gives rise to the flexibility to create various shapes and sizes of the floating system 100 based on site conditions and to suit different needs. Furthermore, the shape and size of the floating system 100 can be easily modified through dismantling and reconnecting the floating structures.

Apart from supporting plants and individuals, the floating system 100 can be configured for use as a floating platform for static displays and also for use as a venue for holding performances out in water bodies, such as reservoirs. A mobile fish farm can also be created offshore by configuring the floating system 100 accordingly. Furthermore, the floating system 100 can be used as an aesthetic feature and can be installed near supporting columns or bridge, or even as a temporary extension to a shoreline.

Although the foregoing invention has been described in some detail by way of illustration and example, and with regard to one or more embodiments, for the purposes of clarity of understanding, it is readily apparent to those of ordinary skill in the art in light of the teachings of this invention that certain changes, variations and modifications may be made thereto without departing from the spirit or scope of the invention as described in the appended claims.

It would be further appreciated that although the invention covers individual embodiments, it also includes combinations of the embodiments discussed. For example, the features described in one embodiment is not being mutually exclusive to a feature described in another embodiment, and may be combined to form yet further embodiments of the invention.

CLAIMS

1. A floating structure arranged to support at least a plant and/or an individual, said structure having an upper surface and one or more sides extending therefrom, the upper surface having one or more apertures and said one or more sides having male and female connectors, with at least one male connector being positioned so as to extend from the side of the structure at a first location and at least one female connector being positioned at a second location on the side or a different side of the structure, said male and female connectors being releasably connectable to corresponding connectors on an adjacent floating structure thereby enabling a plurality of said structures to be connected to one another.

2. A floating structure according to claim 1, wherein the floating structure is polygonal.

3. A floating structure according to any preceding claim, wherein said male and female connectors alternate in height along the side of the structure.

4. A floating structure according to any preceding claim, wherein said male and female connectors alternate in relation to one another on multiple sides of the structure.

5. A floating structure according to any preceding claim, wherein the upper surface has at least one connector to receive one or more platforms to support an individual on the floating structure.

6. A floating structure according to claim 5, wherein the connector is a rim into which the one or more platforms can be inserted.

7. A floating structure according to any preceding claim, wherein the upper surface and said male and female connectors are configured to receive securing means to secure the connection between the floating structure and said adjacent floating structure.

8. A floating structure according to claim 7, wherein said securing means is in the form of a pin which passes through the upper surface, said male and female connectors and said corresponding connectors on said adjacent floating structure to secure the connection between the floating structure and said adjacent floating structure.

9. A floating structure according to any preceding claim, wherein said one or more apertures is a through hole.

10. A floating structure according to claim 10, wherein said through hole is adapted to receive a perforated member to support at least a plant and plant media received in said through hole.

11. A floating structure according to any preceding claim, wherein the floating structure is filled with polyurethane foam.

12. A floating structure according to any preceding claim, wherein the floating structure is hexagonal.

13. A floating structure according to any preceding claim, wherein the floating structure further comprises connecting means for connecting to an anchor.

14. A floating system comprising:

a plurality of floating structures according to any preceding claim connected to one another for supporting at least a plant and/or an individual.

15. A floating system according to claim 14, wherein the system comprises twelve floating structures connected to form a configuration of two structures by six structures.

16. A floating system according to claims 14 or 15, wherein the system further comprises an anchor for anchoring the system.