

NEARSHORE SOLUTIONS

FIELD OF THE INVENTION

This invention relates to nearshore solutions for lifestyle habitats on water. Particularly, this invention relates to a suite of integrated nearshore solutions of infrastructure and live work play modules which is an alternate pathway to help in coastal protection and in combating rising sea levels. The nearshore solutions comprise large modular structures which can be fully prefabricated in the yards and/or factories and combined in various configurations to provide solutions for climate change, coastal protection and large scale infrastructure and built environment spaces. These modules are connected to the land to create an extension of land based developments into the sea space.

BACKGROUND

Climate change may not be discernible to many, but it is a global phenomenon which poses to be one of the gravest challenges facing humankind. Climate change will have devastating consequences including destruction of biodiversity, loss of food sources as well as economic impacts. For many countries, the impact of climate change is evident in warmer spells and heavier rainfalls, with particular severity on rising sea levels.

Conventional static solutions such as building sea walls and land reclamation have been implemented but these are not sustainable solutions.

Thus, those skilled in the art are constantly striving to provide alternative solution for coastal protection, to address the problems of rising sea levels due to climate change, and provide land resiliency to support population growth.

SUMMARY OF THE INVENTION

The above and other problems are solved and an advance in the state of art is made by nearshore solutions in accordance with this invention. A first advantage of the nearshore solutions is that it provides an alternative solution to address rising sea levels due to climate change. A second advantage of the nearshore solutions is that it is an alternative (and complementary) climate change adaption methodology to land reclamation and coastal protection. A third advantage of the nearshore solutions is that it is a re-purposable solution. Specifically, the nearshore solutions is mobile with ability to be deployed and redeployed for a different use at a different location. A fourth advantage of the nearshore solutions is that it is scalable and exportable which can be constructed on-demand basis and be adapted and expanded as and when need arises. A fifth advantage is that the nearshore solutions comprise large modular structures which can be fully prefabricated in the yards and/or factories and combined in various configurations to provide solutions for climate change, coastal protection and large scale infrastructure and built environment spaces.

A first aspect of the invention relates to a nearshore solution. The nearshore solution comprises: a plurality of bottom sitting infrastructure modules defining a boundary of the nearshore solutions infrastructure, each of the plurality of bottom sitting infrastructure modules is adapted to transfer loads of the bottom sitting infrastructure modules to the seabed and withstand surrounding water pressure; a plurality of floating general purpose modules and a plurality of floating infrastructure modules each comprising a restraining fitting adapted to anchor the floating general purpose and the floating infrastructure

modules to an open end of piles extending from the seabed, and a plurality of bottom sitting general purpose modules, plurality of floating general purpose modules, and plurality of floating infrastructure modules; wherein all are arranged within the boundary of the nearshore solutions; as defined by the plurality of bottom sitting infrastructure modules.

5 In one embodiment of the first aspect of the invention, the nearshore solutions infrastructure further comprises gates between two adjacent bottom sitting infrastructure modules.

10 In one embodiment of the first aspect of the invention, each of the plurality of bottom sitting infrastructure modules and the plurality of bottom sitting general purpose modules further comprises: a plurality of columns adapted to transfer loads of the bottom sitting to the seabed; and a hull adapted to withstand surrounding water pressure.

15 In one embodiment of the first aspect of the invention, each of the plurality of bottom sitting infrastructure modules and the plurality of bottom sitting general purpose modules further comprises: a top layer above a water level and adapted for lifestyle and transportation facilities; a lowest layer configured for storage; and a plurality of basement layers between the top layer and lowest layer configured for basement lifestyle and transportation network, utility storage facility.

20 In one embodiment of the first aspect of the invention, the lowest layer comprises a ballast system for controlling a buoyancy of the bottom sitting infrastructure module or bottom sitting general purpose module.

In one embodiment of the first aspect of the invention, the plurality of basement layers are open spaces.

25 In one embodiment of the first aspect of the invention, each of the bottom sitting infrastructure modules and bottom sitting general purpose modules comprise concrete spacers set in place at the bottom of bottom sitting infrastructure module or bottom sitting general purpose module as a means to adjust a height of the bottom sitting infrastructure module or bottom sitting general purpose module.

In one embodiment of the first aspect of the invention, the concrete spacers are concrete blocks.

30 In one embodiment of the first aspect of the invention, each of the plurality of floating general purpose modules and the plurality of floating infrastructure modules further comprises: a first basement layer; and a second basement layer, wherein the restraining fittings are provided along a perimeter of the floating general purpose module or floating infrastructure module and integrally coupled to the sidewall of the first and second basement layers.

35 In one embodiment of the first aspect of the invention, the restraining fittings includes rollers between the pile and a guide within the restraining fittings to ensure that the floating general purpose module or floating infrastructure module is restraint by the piles in a lateral direction that is perpendicular to a surface of the first basement layer.

40 In one embodiment of the first aspect of the invention, the second basement layer comprises a ballast system for controlling the buoyancy of the floating general purpose module or floating infrastructure module.

45 In one embodiment of the first aspect of the invention, the ballast system is an active compensating ballast system adapted to maintain the floating general purpose module or floating infrastructure module to a specific draft and upright.

In one embodiment of the first aspect of the invention, the first basement layer comprises internal spaces for basement lifestyle, transport and utility infrastructure for storage, energy generation and power plants.

In one embodiment of the first aspect of the invention, the bottom sitting general purpose modules and floating general purpose modules are hexagonal in shape.

In one embodiment of the first aspect of the invention, the nearshore solution further comprises flexible coupling arm configured to couple the bottom sitting infrastructure modules and floating general purpose modules together.

In one embodiment of the first aspect of the invention, the bottom sitting modules and floating modules will be manufactured using sustainable materials, subject to further technical and cost assessment.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages in accordance with this invention are described in the following detailed description and are shown in the following drawings:

Figure 1 illustrating a floating infrastructure in accordance with an embodiment of this disclosure;

Figure 2 illustrating an infrastructure bottom sitting module in accordance with an embodiment of this disclosure;

Figure 3 illustrating a general purpose bottom sitting module in accordance with an embodiment of this disclosure;

Figure 4 illustrating an infrastructure floating module in accordance with an embodiment of this disclosure;

Figure 5 illustrating a general purpose floating module in accordance with an embodiment of this disclosure; and

Figure 6 illustrating a cross sectional view of a restraining fitting coupled to a dolphin pile in accordance with an embodiment of this disclosure.

DETAILED DESCRIPTION

This invention relates to nearshore solutions for lifestyle habitats on water. Particularly, this invention relates to a suite of integrated nearshore solutions of infrastructure and general purpose or live, work, play modules which is an alternative pathway to help in coastal protection and in combating rising sea levels. The nearshore solutions comprise modules which create integrated living sea wall to provide coastal protection and create new urban spaces. These modules are connected to the land to create an extension of land based developments into the sea space.

It is envisaged that sea level may rise by 0.63m in this century and global sea surface temperature could increase between 1 to 4°C due to climate change and global warming, causing destruction of coastal cities and coastal marine biodiversity. Hence, in accordance with embodiments of this invention, the nearshore solutions of this invention provides an alternative resilient and sustainable source of land which is constructed with low/zero carbon sustainable materials. The nearshore solutions can be used to house smart and energy efficient buildings, with power generated by renewable energy sources. Further, as the structures and installations to construct the nearshore solutions are modular in nature, the nearshore solutions has enhanced scalability and adaptability which enables it to be deployed globally. Taking up sea space for floating cities may obstruct existing

vessel routes and anchorage locations, modularity of the nearshore solutions ensures that the sea space reserved for the floating city is utilized fully.

Unlike the design for offshore floating structures such as semi-submersible where the primary function is to be stationed out at sea for oil well drilling operations, the design for nearshore solutions for live, work, play purposes requires a more in-depth study into the human comfort level. A maximum acceleration value taking reference from classification rule recommendation has been used in the design of the invention, human can perceive the movement and become seasick when acceleration exceeds that limit.

The nearshore solutions is an alternate sustainable pathway which can combat the impact of rising sea levels and at the same time create new habitats and lifestyle spaces above and below water. Furthermore, the comfort level of the occupants of the floating platform should not be compromised even if the environmental conditions are different as compared to land based fixed structures.

The nearshore solutions also includes the following green features to promote sustainability; of which will be adopted subject to further technical and cost assessment:

- Adopt the use of green concrete such as carbon cure concrete, concrete which utilizes recycled concrete aggregates (RCA) or even concrete that utilizes cement replacement technology. The technologies help in reducing carbon output by utilizing emitted carbon dioxide for the curing of cement or conversion into fuels and other beneficial products. Cement replacement technology enables the production of concrete without the need for Portland cement, replacements such as steel slag, a waste material from steel-making plants can be used to bind the concrete instead.

- Install solar panels on the roof of the topside structures

- Harvest rainwater and treatment facilities on the roof of the topside structures

- Green coverage and green walls to promote greenery

The nearshore solutions comprise of infrastructure and live, work, play modules.

For the infrastructure modules, there are bottom sitting modules and floating infrastructure modules. The bottom sitting modules act as the seawall for coastal protection. The floating infrastructure modules are for lighter loads.

For the general purpose or live, work, play modules, there are bottom sitting modules and floating modules. The bottom sitting modules cater for heavier loads and thus buildings or topside structures with higher number of storeys. The floating modules cater for lighter loads with topside structures with less number of storeys.

The bottom sitting infrastructure modules form the seawall to provide coastal protection and form a lagoon. The floating infrastructure modules, bottom sitting and floating general purpose or live, work, play modules are formed within this lagoon to create a nearshore township. The bottom sitting infrastructure module forming the seawall has provision for openings / gates to allow for emergency/ maintenance access in and out of the lagoon and also to allow for water movement between the lagoon and the open sea. Details of the infrastructure and general purpose for live, work, play modules of the nearshore solutions would be described as follows.

Introduction of Nearshore solution 100 (Master Plan)

Figure 1 shows a nearshore solution 100 in accordance with an embodiment of this invention. The nearshore solution 100 comprises bottom sitting infrastructure modules 110, floating infrastructure modules 130 and general purpose modules (Bottom sitting or floating) 120. The general purpose modules 120 are meant for live, work and play. Hence,

general purpose modules 120 may also be known as general purpose live, work and play modules 120. The general purpose modules 120 may be bottom sitting or floating, depending on the requirements. Figure 2 shows the bottom sitting infrastructure module 110, figure 3 shows the bottom sitting general purpose module 120, figure 4 shows floating infrastructure module 130 and figure 5 shows floating general purpose module 120. Gates 150 are provided between two bottom sitting infrastructure modules 110 to allow vessels to enter and exit the nearshore solution 100.

The bottom sitting infrastructure modules 110 are arranged in a manner defining a boundary of the nearshore solution 100 as well as a form of coastal protection sea wall, where each of bottom sitting modules 110 are designed to transfer the loads of the bottom sitting infrastructure module 110 to the seabed and the hull of the modules are designed to withstand the surrounding water pressure.

The floating infrastructure module 130 and floating general purpose module 120 comprise a restraining fitting adapted to anchor the floating infrastructure module 130 and floating general purpose module 120 to an open end of piles (such as dolphin piles) extending from the seabed. The bottom sitting general purpose module 120, floating infrastructure module 130 and floating general purpose module 120 are arranged within the boundary of the bottom sitting infrastructure modules 110. In this arrangement, the floating infrastructure module 130 and floating general purpose module 120 would be in a lagoon area, protected by the bottom sitting infrastructure modules 110 which act as a sea wall forming the lagoon area.

Each general purpose module 120 has an area of 5,000sqm, which is able to accommodate approximately 2000 occupants and 3 general purpose module 120 when connected together can accommodate up to 6000 occupants. The figures may vary depending on how the topside structures are designed, whether they are used more for apartments, offices or other recreational purposes.

To reduced greenhouse gas emission, the modules 110/120/130 are manufactured using green concrete technology that either takes in carbon dioxide for curing or replaces cement with alternative materials such as metal slags, silica binders and concrete which utilizes recycled concrete aggregates (RCA). Further, each module 110/120/130 is made of enhanced concrete structure with bee-hive like configuration such as honey comb structure, to provide rigid strength and redundancy.

The space on the top surface of the modules 110/120/130 can be used for features such as: roads, parks and gardens, shopping malls, park connectors, etc. The space in the basement levels can be used for features such as: train tunnel/station, underground shopping space, storage space, carparks, underground tunnels, space for water, waste and power connection from shore, etc. More details will be described below.

While figure 1 shows the modules 110/120/130 having the same dimension, one skilled in the art will recognise that non-uniform modules 110/120/130 may be implemented without departing from the invention. Furthermore, the modules 110/120/130 may be hexagonal in shape so that they can be easily be interconnected to form a larger cluster.

Bottom sitting module

The bottom sitting infrastructure modules 110 are constructed in a manner to define the boundary, also known as the perimeter, of the nearshore solution 100 forming a lagoon area within the boundary. The bottom sitting infrastructure modules 110 act as a form of coastal protection sea wall to solve the problem of rising sea level. It is also considered as

a form of coastal protection sea wall. As shown in figure 1, the boundary of the nearshore solution 100 is defined by the shoreline and the bottom sitting infrastructure modules 110. However, one skilled in the art will recognise that the nearshore solution 100 may be built beyond the shore line 190 with a number of the bottom sitting infrastructure modules 110 may be interconnected together to define a perimeter of the nearshore solution 100 without departing from the invention

There are two types of bottom sitting module, namely, a bottom sitting infrastructure module 110 as shown in figure 1 where details of the bottom sitting infrastructure module is referred to as 110a in figure 2 and a bottom sitting general purpose module 120 as shown in figure 1 where details of the bottom sitting general purpose module is referred to 120a in figure 3.

As shown in figures 2 and 3, the bottom sitting modules 110a/120a would be sitting directly on the seabed. Hence, it is necessary to ensure that the seabed is as flat and regular as possible. If the seabed is irregular or undulating, the sitting structure of the bottom sitting modules 110a/120a sitting on it will suffer the risk of spanning and overstressing. To avoid such risks, marine geophysical surveys should be conducted in preparation of the seabed preparation works. The survey will be able to identify any anomalies on the surface of the seabed, map rocks and buried objects within the upper unconsolidated marine sediments and reveal information on the nature of the seabed. After the survey is completed, the seabed would be prepared by removing a top layer or by laying a layer of material on the seabed to create a flatbed.

Gates 150 are provided between the bottom sitting modules 110a/120a defining the perimeter of the floating infrastructure to allow vessels to enter and exit the nearshore solution 100. Essentially, the bottom sitting modules 110a/120a are used for coastal protection seawall and flood control.

After fabrication, assembly and commissioning in yard, the bottom sitting modules 110a/120a would be floated to the location of installation by deballasting the ballast system in the lowest layer 110a4/120a3 and subsequently ballasted down onto the seabed. Similarly, the bottom sitting modules 110a/120a can be deballasted and relocated as and when required. Therefore, the ballast tanks in the ballast system in the lowest layer 110a4/120a3 are provided to allow the transportation of the bottom sitting modules 110a/120a during installation as well as any future relocation possibilities.

Bottom sitting modules – Internal Components

The bottom sitting infrastructure module 110a comprises a top layer 110a1, first basement layer 110a2, second basement layer 110a3 and lowest layer 110a4. The top layer 110a1 is for lifestyle and transportations such as malls, parks and roads. The first basement layer 110a2 is configured for internal spaces used for basement car parks, underground malls etc. The second basement layer 110a3 is configured for infrastructure uses such as storage, energy generations, power plants and train tunnels. The lowest layer 110a4 is configured for storage and ballast system. One skilled in the art will recognise that more basement layers may be added between the top layer 110a1 and lowest layer 110a4 and this is dependent on the depth of the water level to the seabed. The bottom sitting infrastructure module 110a comprises columns 110a8/110a9/110a10 for transferring the loads of the bottom sitting infrastructure module 110 to the seabed.

The bottom sitting general purpose module 120a comprises a top layer 120a1, multiple basement layers 120a2 and a lowest layer 120a3. The top layer 120a1 is for

lifestyle and transportations such as malls, parks and roads. Different from the infrastructure module 110a, the top layer 120a1 is configured for mid to high density developments such as 8 to 15 floors. The basement layers 120a2 are configured for internal spaces used for basement carparks, underground malls etc and infrastructure uses such as storage, energy generations, power plants and train tunnels. The lowest layer 120a3 is configured for storage and ballast system. One skilled in the art will recognise that the number of basement layers 120a2 is dependent on the depth of the water level to the seabed.

Figure 2 illustrates a cross section view of the bottom sitting infrastructure module 110a. On the left of figure 2 shows the water level 110a5 while the right of figure 3 shows water level 110a6 at high tide water and water level at low tide 110a7. To address the potential rise in water level due to global warming and climate change, adequate freeboard (distance between the water level and top surface) will be designed in consideration for the rise in water level in the future. As an added measure for future proofing, the bottom sitting infrastructure module 110a or bottom sitting general purpose module 120a will be designed to be able to withstand the water pressure and loadings of the increased water level, if required in the future, additional sea walls can be constructed offsite and installed at top layer 110a1 of the bottom sitting infrastructure module 110a or bottom sitting general purpose module 120a.

The bottom sitting modules 110a/120a comprise a concrete spacer set in place at the bottom of the structure as a means to adjust the height of the bottom sitting module 110a/120a to satisfy the freeboard requirements. Concrete spacers are essentially concrete blocks that are arranged between the lowest layer 110a4/120a3 and the seabed.

Floating modules

Similar to the bottom sitting module 110a/120a, there are two types of floating modules, namely, a floating infrastructure module 130 as shown in figure 1 where details of the floating infrastructure module is referred to as 130a in figure 4 and a floating general purpose module 120 as shown in figure 1 where details of the floating general purpose module is referred to as 120b in figure 5. Floating infrastructure module 130a is designed to allow lighter infrastructure services, and for transport network such as vehicles to travel through or park connectors while floating general purpose module 120b is designed to accommodate residential, office and recreational facilities.

As shown in figures 4 and 5, the floating modules 130a/120b would be anchored by dolphin piles. The floating modules 130a/120b accommodate light structures above the water level and is configured for low to mid density developments such as 3 to 8 floors above the top surface as shown in figure 5. As floating modules 130a/120b are floating type modules, they are flexible and independent of seabed depth and condition of the seabed. Hence, it is not necessary to have major seabed preparations below the floating modules 130a/120b.

After fabrication, assembly and commissioning in yard, the floating modules 130a/120b would be floated to the location of installation by deballasting the ballast system in the second basement layer 130a2/120b2 and subsequently ballasted down with the top of the dolphin piles extending into the restraining fittings 730. Similarly, the floating modules 130a/120b can be deballasted and relocated as and when required.

Floating modules – Internal Components

As shown in figure 6, the floating module 130a/120b is anchored to the seabed by dolphin piles 710 with a top portion 720 of the dolphin piles extending into a restraining fitting 730 adapted to allow vertical motion in accordance with the water level and prevent horizontal motion to fix the floating module 130a/120b at a location. As shown in figure 6, the restraining fitting 730 is integrally coupled to the sidewall of the first basement layer 130a1/120b1 and second basement layer 130a2/120b2. A through opening is provided at the bottom of the restraining fitting 730 so that the top portion 720 of the dolphin pile can be inserted into the through opening, securing the floating module 130a/120b to the dolphin piles. The restraining fitting 730 includes a cover 731 for covering the top of the through opening. This cover 731 is height adjustable to accommodate the length of the dolphin pile inserted into the through opening.

As shown in figures 4 and 5, the floating module 130a/120b comprises 2 levels below the top surface namely, first basement layer 130a1/120b1 and second basement layer 130a2/120b2. The restraining fittings 730 are provided along a perimeter of the floating module 130a/120b and integrally coupled to the sidewall of the first basement layer 130a1/120b1 and second basement layer 130a2/120b2. The restraining fittings 730 may include rollers between the dolphin pile and a guide within the restraining fittings 730 to ensure that the floating module 130a/120b is restrained by the dolphin piles in the lateral direction, i.e. up and down movement due to change in water level within the boundary of the nearshore solution 100 or overall load of the floating module.

The second basement layer 130a2/120b2 comprises ballast system for controlling the buoyancy of the floating module 130a/120b. An active compensating ballast system is installed in this level to constantly monitor and keep the platform stable. Specifically, the active ballast system will constantly monitor the draft and tilt of the floating module and perform adequate ballasting to keep the floating module 130a/120b to the specified draft and upright. In one embodiment, an active ballast system might not be required if the live loads (moving loads from humans, vehicles, etc) is considerably small compared to the overall module as the movements will not cause much changes to the draft/tilt of the floating module 130a/120b. The ballast system in the second basement layer 130a2/120b2 is provided to allow the transportation of the floating modules 130a/120b during installation as well as any future relocation possibilities.

The first basement layer 130a1/120b1 comprises internal spaces for basement lifestyle, transport and utility infrastructure for storage, energy generation and power plants. Depending on the planning and placement of the bottom sitting and floating modules, as there will be sharing of Mechanical and Electrical facilities among the connected modules 120/130 in figure 1, energy generation and power plant facilities will not be required for every module in a connecting cluster.

For example, in a cluster of 3 modules 120/130, a single power generating facility would need to be residing in one of the 3 modules and hence the spaces of the other 2 modules can be used for other purposes. Hence, the actual configuration of the first basement layer 130a1/120b1 is left as a design choice to those skilled in the art.

The floating infrastructure module 130a and floating general purpose module 120b may be connected together via rigid or flexible connectors. The rigid connectors will basically link 2 modules 130a/120b together to form a single larger module. Flexible connectors allow the modules 130a/120b to retain some individuality and variations in draft without impeding each other. A flexible coupling arm is an example of a flexible connector

that can be easily installed and disengaged, keeps the platforms secured at a safe distance from one another and also couples the motions of each module 130a/120b in a cluster. For the avoidance of doubt, each cluster may be formed using 2 or more floating infrastructure modules 130a, 2 or more floating general purpose modules 120b, or combination of floating infrastructure modules 130a and floating general purpose modules 120b.

The above is a description of exemplary embodiments of a nearshore solution in accordance with this invention. It is foreseeable that those skilled in the art can and will design alternative infrastructures, installations, systems and methods based on this disclosure that infringe upon this invention as set forth in the following claims.

CLAIMS

1. A nearshore solution comprising:

a plurality of bottom sitting infrastructure modules defining a boundary of the nearshore solution, each of the plurality of bottom sitting infrastructure modules is adapted to transfer loads of the bottom sitting infrastructure modules to a seabed and withstand surrounding water pressure;

a plurality of floating general purpose modules and a plurality of floating infrastructure modules, each comprising a restraining fitting adapted to anchor the floating general purpose module to an open end of piles extending from the seabed,

a plurality of bottom sitting general purpose modules wherein the plurality of floating general purpose modules, plurality of floating infrastructure modules and plurality of bottom sitting general purpose modules are arranged within the boundary of the nearshore solution.

2. The nearshore solution according to claim 1 further comprising gates between two adjacent bottom sitting infrastructure modules.

3. The nearshore solution according to claim 1 wherein each of the plurality of bottom sitting infrastructure modules and the plurality of bottom sitting general purpose modules further comprises:

a plurality of columns adapted to transfer loads of the bottom sitting to the seabed; and

a hull adapted to withstand surrounding water pressure.

4. The nearshore solution according to claim 1 wherein each of the plurality of bottom sitting infrastructure modules and the plurality of bottom sitting general purpose modules further comprises:

a top layer above a water level and adapted for lifestyle and transportation facilities;

a lowest layer configured for storage; and

a plurality of basement layers between the top layer and lowest layer configured for basement lifestyle and transportation network, utility storage facility.

5. The nearshore solution according to claim 4 wherein the lowest layer comprises a ballast system for controlling a buoyancy of the bottom sitting infrastructure module or bottom sitting general purpose module.

6. The nearshore solution according to claim 4 wherein the plurality of basement layers are open spaces.

7. The nearshore solution according to anyone of claims 1-6 wherein each of the bottom sitting infrastructure modules and bottom sitting general purpose modules comprise concrete spacers set in place at the bottom of bottom sitting infrastructure module or bottom sitting general purpose module as a means to adjust a height of the bottom sitting infrastructure module or bottom sitting general purpose module.

8. The nearshore solution according to claim 7 wherein the concrete spacers are concrete blocks.

9. The nearshore solution according to claim 1 wherein each of the plurality of floating general purpose modules and the plurality of floating infrastructure modules further comprises:

a first basement layer; and

a second basement layer, wherein the restraining fittings are provided along a perimeter of the floating general purpose module or floating infrastructure module and integrally coupled to the sidewall of the first and second basement layers.

10. The nearshore solution according to claim 9 wherein the restraining fittings includes rollers between the pile and a guide within the restraining fittings to ensure that the floating general purpose module or floating infrastructure module is restraint by the piles in a lateral direction that is perpendicular to a surface of the first basement layer.

11. The nearshore solution according to claim 10 wherein the second basement layer comprises a ballast system for controlling the buoyancy of the floating general purpose module or floating infrastructure module.

12. The nearshore solution according to claim 11 wherein the ballast system is an active compensating ballast system adapted to maintain the floating general purpose module or floating infrastructure module to a specific draft and upright.

13. The nearshore solution according to claim 12 wherein the first basement layer comprises internal spaces for basement lifestyle, transport and utility infrastructure for storage, energy generation and power plants.

14. The nearshore solution according to any one of claims 1-13 wherein the bottom sitting general purpose modules, floating infrastructure modules and floating general purpose modules are hexagonal in shape.

15. The nearshore solution according to any one of claims 1-14 further comprising flexible coupling arm configured to couple the bottom sitting infrastructure modules and floating general purpose modules together.

16. The nearshore solution according to any one of claims 1-15 wherein the bottom sitting modules and floating general purpose modules can be considered to be manufactured using recycled concrete aggregates (RCA), subject to further technical and cost assessment.