

MULTIFUNCTIONAL BAMBOO SCRIMBER OR WOOD FREIGHT CONTAINER AND MANUFACTURING METHOD THEREOF

TECHNICAL FIELD

5 **[0001]** The present invention relates to a multifunctional bamboo scrimber (BS) or wood freight container and a manufacturing method thereof, belonging to the technical field of cargo transportation equipment, and is particularly suitable for scenarios such as maritime transportation, land transportation, and warehousing of various types of goods.

TECHNICAL BACKGROUND

10 **[0002]** In modern cargo transportation systems, containers serve as key equipment, and their performance and material selection are of critical importance. Traditional steel containers have been widely used for a long time. However, with the continuous development of the industry, their inherent limitations have gradually become more apparent.

15 **[0003]** Steel containers have a significantly high self-weight. In road transportation, vehicles must consume additional fuel to carry the weight of the container itself. For example, a truck with a load capacity of 10 tons, when equipped with a traditional steel container, may experience a reduction in actual cargo capacity of 1-2 tons due to the excessive self-weight of the container. Additionally, fuel consumption may increase by 10%-15%, leading to a significant rise in
20 transportation costs.

25 **[0004]** Generally, steel containers that have been in use for 3–5 years will exhibit obvious signs of rust, requiring maintenance such as derusting and repainting. Each maintenance cycle not only consumes substantial human and material resources—including the purchase of derusting equipment, protective coatings, and other materials—but also involves labor costs. According to statistics, maintenance costs typically account for approximately 5%-10% of the container's original cost. Furthermore, frequent maintenance leads to container downtime, reducing usage

efficiency and affecting the continuity and timeliness of transportation operations.

[0005] In terms of resource consumption and environmental impact, steel production is a process characterized by high energy consumption and high pollution. Producing one ton of steel requires approximately 1.5-2 tons of iron ore and 0.5-0.6 tons of coal, while emitting about 1.6 tons of carbon dioxide and generating a large amount of pollutants such as waste residue and exhaust gases. With increasing global emphasis on environmental protection and sustainable development, the disadvantages of traditional steel containers in terms of resource consumption and environmental impact have become increasingly prominent, making them incompatible with the requirements of modern society for green and low-carbon economic development.

[0006] Although attempts have been made to improve containers using lightweight materials such as aluminum alloys, the cost of aluminum alloys is significantly higher—approximately 20%-30% more than that of steel. Moreover, aluminum alloys have certain limitations in terms of strength and impact resistance, making it difficult to meet the demanding requirements of containers in complex service environments. For instance, aluminum alloy containers are more prone to deformation and damage when subjected to collisions during loading and unloading operations.

SUMMARY OF THE INVENTION

[0007] To solve the above problems, the first objective of the present invention is to provide a multifunctional BS or wood container that is light in weight, high in strength, corrosion-resistant and environmentally friendly.

[0008] The second objective of the present invention is to provide a preparation method for the multifunctional BS or wood container.

[0009] The present invention discloses a multifunctional BS or wood container, which is composed of an AFRP-steel-BS/wood frame structure with anti-corrosion, anti-mildew and anti-ultraviolet coatings on the surface, and an enclosure structure. The AFRP-steel-BS/wood frame

structure consists of AFRP-BS/wood corner posts, AFRP-BS/wood corner post middle columns, AFRP-BS/wood or steel longitudinal bottom edge beams, AFRP-BS/wood longitudinal top edge beams, AFRP-BS/wood or steel transverse short beams, bottom AFRP-BS/wood middle longitudinal short beams and AFRP-BS/wood diagonal braces. Moreover, the AFRP-steel-BS/wood frame structure is connected via AFRP-steel-corner fittings connectors, AFRP-steel sleeve connectors, AFRP-steel connectors, and diagonal "T"-shaped AFRP-steel connectors. The AFRP-BS/wood or steel longitudinal bottom edge beams and AFRP-BS/wood longitudinal top edge beams are integrally press-formed and arranged in a full-length manner. Both ends of the first bottom steel transverse short beams, which serve as the bottom edge beams of the AFRP-steel-BS/wood frame structure among the AFRP-BS/wood or steel transverse short beams, are provided with a "Men"-shaped (portal-shaped with two vertical supports and one horizontal top beam) structure. The enclosure structure includes doors, BS/wood bottom slabs, BS/wood top slabs, BS/wood longitudinal side slabs and BS/wood transverse side slabs, and the enclosure structure is installed on the periphery of the AFRP-steel-BS/wood frame structure.

[0010] Further, the AFRP-steel-BS/wood frame structure is a rectangular three-dimensional structure. The AFRP-steel-corner fittings connectors include four top AFRP-steel-corner fittings connectors respectively located at the four corners of the top of the rectangular three-dimensional structure and four bottom AFRP-steel-corner fittings connectors respectively located at the four corners of the bottom of the rectangular three-dimensional structure. The AFRP-BS/wood corner posts include two first AFRP-BS/wood corner posts located at one port of the rectangular three-dimensional structure and two second AFRP-BS/wood corner posts located at the other port of the rectangular three-dimensional structure. The first AFRP-BS/wood corner posts and the second AFRP-BS/wood corner posts are respectively fixedly installed between the top AFRP-steel-corner fittings connectors and the bottom AFRP-steel-corner fittings connectors that are located on the same straight line via AFRP-steel sleeve connectors. The AFRP-BS/wood or steel transverse short beams include first bottom steel transverse short beams, second AFRP-BS/wood transverse short

beams, third AFRP-BS/wood transverse short beams, fourth AFRP-BS/wood transverse short beams and fifth AFRP-BS/wood transverse short beams. The first bottom steel transverse short beams are located at the short sides of the bottom rectangle of the rectangular three-dimensional structure and fixedly installed between two adjacent bottom AFRP-steel-corner fittings connectors.

5 The second AFRP-BS/wood transverse short beams are on the same side as the two first AFRP-BS/wood corner posts, and the second AFRP-BS/wood transverse short beams are fixedly installed between the two top AFRP-steel-corner fittings connectors. The third AFRP-BS/wood transverse short beams are on the same side as the two second AFRP-BS/wood corner posts, and the third AFRP-BS/wood transverse short beams are fixedly installed between the two top AFRP-steel-
10 corner fittings connectors. The AFRP-BS/wood or steel longitudinal bottom edge beams are located at the long sides of the bottom rectangle of the rectangular three-dimensional structure and fixedly installed between two adjacent bottom AFRP-steel-corner fittings connectors. The AFRP-BS/wood longitudinal top edge beams are located at the long sides of the top rectangle of the rectangular three-dimensional structure and fixedly installed between two adjacent top AFRP-
15 steel-corner fittings connectors. The fourth AFRP-BS/wood transverse short beams are fixedly installed between the two AFRP-BS/wood longitudinal top edge beams at intervals not exceeding 1.5 meters along the longitudinal direction. The fifth AFRP-BS/wood transverse short beams are fixedly installed between the two AFRP-BS/wood or steel longitudinal bottom edge beams at intervals not exceeding 1.5 meters along the longitudinal direction.

20 **[0011]** Further, the bottom AFRP-BS/wood middle longitudinal short beams are located at the center of the bottom rectangle of the rectangular three-dimensional structure, and both ends of the bottom AFRP-BS/wood middle longitudinal short beams are fixedly connected to the adjacent first bottom steel transverse short beams and fifth AFRP-BS/wood transverse short beams or to two adjacent fifth AFRP-BS/wood transverse short beams.

25 **[0012]** Further, a plurality of AFRP-BS/wood corner post middle columns are provided. Some of the AFRP-BS/wood corner post middle columns are fixedly installed between the AFRP-

BS/wood or steel longitudinal bottom edge beams and AFRP-BS/wood longitudinal top edge beams located in the same vertical plane via second AFRP-steel connectors, and the remaining AFRP-BS/wood corner post middle columns are fixedly installed between the first bottom steel transverse short beams and third bottom steel transverse short beams via second AFRP-steel connectors.

[0013] Further, AFRP-BS/wood diagonal braces are respectively installed between the AFRP-BS/wood corner posts and AFRP-BS/wood or steel longitudinal bottom edge beams, between the AFRP-BS/wood middle columns and AFRP-BS/wood or steel longitudinal bottom edge beams, between the AFRP-BS/wood longitudinal top edge beams and first AFRP-BS/wood corner posts, between the AFRP-BS/wood longitudinal top edge beams and second AFRP-BS/wood transverse short beams, between the second AFRP-BS/wood corner posts and AFRP-BS/wood longitudinal top edge beams, and between the second AFRP-BS/wood corner posts and third AFRP-BS/wood transverse short beams via diagonal "T"-shaped AFRP-steel connectors. Two adjacent AFRP-BS/wood diagonal braces connected to the AFRP-BS/wood or steel longitudinal bottom edge beams are in an inverted "V"-shaped.

[0014] Further, the BS/wood bottom slabs are installed on the inner side of the bottom of the AFRP-steel-BS/wood frame structure, and the BS/wood top slabs, BS/wood longitudinal side slabs and BS/wood transverse side slabs are installed on the outer side of the AFRP-steel-BS/wood frame structure.

[0015] Further, the doors include end doors, top doors, and side doors. The end doors are installed between the two first AFRP-BS/wood corner posts, the top doors are installed in the middle of the top of the AFRP-steel-BS/wood frame structure. The side doors are installed on the side of the AFRP-steel-BS/wood frame structure.

[0016] Further, the doors can be provided at one, two or three positions among the top, side and end of the AFRP-steel-BS/wood frame structure.

[0017] Further, the multifunctional BS or wood container can be used as a mobile house.

[0018] Further, the doors are made of metal materials, or one or a combination of multiple materials among bamboo glulam, BS, bamboo woven glued materials, bamboo-plastic composite materials, bamboo particle composite materials, bamboo scrap profiles, wood, and straw.

[0019] Further, the AFRP can be replaced with one of glass fiber, carbon fiber and basalt fiber, or a combination of multiple materials among glass fiber, carbon fiber, AFRP and basalt fiber, or no AFRP is used according to the service life requirements.

[0020] Further, the quantity and arrangement of each component of the AFRP-steel-BS/wood frame structure can be increased or decreased according to the weight tolerance and service conditions.

[0021] Further, the AFRP-BS/wood or steel longitudinal bottom edge beams and AFRP-BS/wood longitudinal top edge beams can be formed by splicing two or more pieces, and the connection is reliable.

[0022] Further, the BS can be replaced with one of bamboo glulam, bamboo woven glued materials, bamboo-plastic composite materials, bamboo particle composite materials, bamboo scrap profiles, wood, bamboo-wood composite materials and straw, or a combination of multiple materials among BS, bamboo glulam, bamboo woven glued materials, bamboo-plastic composite materials, bamboo particle composite materials, bamboo scrap profiles, wood, bamboo-wood composite materials and straw.

[0023] Based on the same inventive concept, the present invention also discloses a preparation method for a multifunctional BS or wood container, comprising the following steps:

[0024] Step 1: Prepare AFRP-steel-corner fittings connectors. The AFRP-steel-corner fittings connectors are formed by integrally combining corner fittings, AFRP-steel sleeves, AFRP-"Gong"-shaped (I-shaped with upper and lower horizontal segments) steel, and AFRP-steel plates. The corner fitting is a cubic hollow component, with three mutually adjacent faces provided with holes for fixed connection during loading and unloading of the container. The other three non-porous faces are respectively welded with steel sleeves, "Gong"-shaped steel or end beams. The

centroid of the steel sleeve and the centroid of the corner fitting are on the same straight line, or the horizontal projection distance between the two centroids is less than one-fifth of the length of the short side of the steel sleeve. The surface layers of the steel sleeves, "Gong"-shaped steel or end beams are wrapped with AFRP. Prepare AFRP-steel sleeve connectors, AFRP-steel connectors and diagonal "T"-shaped AFRP-steel connectors, and wrap AFRP on the surface layers of the materials of AFRP-steel sleeve connectors, AFRP-steel connectors and diagonal "T"-shaped AFRP-steel connectors. manufacture BS/wood components required for the AFRP-steel-BS/wood frame structure and the enclosure structure, and wrap AFRP on the outer surfaces of the components.

[0025] Step 2: Assemble the AFRP-steel-BS/wood frame structure. Connect AFRP-BS/wood or steel longitudinal bottom edge beams, first bottom steel transverse short beams and AFRP-BS/wood corner posts by using bottom AFRP-steel-corner fittings connectors. Connect AFRP-BS/wood longitudinal top edge beams, second AFRP-BS/wood transverse short beams, third AFRP-BS/wood transverse short beams and AFRP-BS/wood corner posts by using top AFRP-steel-corner fittings connectors. Connect the two AFRP-BS/wood or steel longitudinal bottom edge beams by using fifth AFRP-BS/wood transverse short beams at intervals not exceeding 1.5 meters along the longitudinal direction. Connect the first bottom steel transverse short beams and the fifth AFRP-BS/wood transverse short beams pairwise along the midpoint by using bottom AFRP-BS/wood middle longitudinal short beams. Connect the two AFRP-BS/wood longitudinal top edge beams by using fourth AFRP-BS/wood transverse short beams at intervals not exceeding 1.5 meters along the longitudinal direction. Connect AFRP-BS/wood middle columns with AFRP-BS/wood or steel longitudinal bottom edge beams and AFRP-BS/wood longitudinal top edge beams or third AFRP-BS/wood transverse short beams by using second AFRP-steel connectors. Connect AFRP-BS/wood middle columns, AFRP-BS/wood corner posts with AFRP-BS/wood or steel longitudinal bottom edge beams by using two AFRP-BS/wood diagonal braces in an inverted "V"-shaped. Connect AFRP-BS/wood longitudinal top edge beams with first AFRP-BS/wood

corner posts and second AFRP-BS/wood transverse short beams by using AFRP-BS/wood diagonal braces. Connect second AFRP-BS/wood corner posts with AFRP-BS/wood longitudinal top edge beams and third AFRP-BS/wood transverse short beams by using AFRP-BS/wood diagonal braces.

5 **[0026]** Step 3: Install BS/wood bottom slabs on the inner side of the AFRP-steel-BS/wood frame structure, and install BS/wood top slabs, BS/wood longitudinal side slabs and BS/wood transverse side slabs on the outer side of the AFRP-steel-BS/wood frame structure. Install end doors between the first AFRP-BS/wood corner posts, and install top doors at the middle position of the top of the AFRP-steel-BS/wood frame structure. Install side doors on the side of the AFRP-steel-BS/wood frame structure. Perform anti-corrosion, anti-mildew and anti-ultraviolet treatment on the container enclosure structure.

15 **[0027]** Step 4: Treat the surface of the BS plates with a flexible water-based organosilicon superhydrophobic and antifouling coating. The coating is cross-linked through hydrosilylation reaction with high molecular weight divinyl-terminated polydimethylsiloxane (ViPDMSVi) and methyl vinyl MQ resin (MVMQ-resin) as raw materials, and polyether-modified organosilicon (D(PDMS)PE) and sodium dodecyl sulfate (SDS) as composite emulsifiers. The static water contact angle (WCA) of the coating is $\geq 150^\circ$, the sliding angle (SA) is $\leq 10^\circ$, and the coating can form a superhydrophobic interface. The tensile strength of the coating is $\geq 3.5\text{MPa}$, the elongation at break is $\geq 214\%$, and the coating can adapt to the dry-wet deformation of bamboo. The impedance radius of the coating in 3.5% NaCl solution is $\geq 1.2 \times 10^9 \Omega \cdot \text{cm}^2$, and the inhibition rate of the coating against Staphylococcus aureus is $\geq 99\%$.

20 **[0028]** The beneficial effects of the present invention are as follows:

25 **[0029]** Lightweight and efficient: The BS used in the present invention has a density of only about 1/5-1/4 that of steel, and this characteristic makes the 40-foot BS frame container show great advantages in terms of weight. The self-weight of traditional 40-foot steel containers is usually about 4-5 tons, while the self-weight of the container of the present invention can be reduced to

more than 3.2 tons. The reduction in self-weight directly leads to a significant increase in the effective load capacity. Compared with traditional steel containers, the effective load capacity of a single container of the present invention can be increased by more than 1.8 tons. During transportation, fuel consumption is closely related to the load of vehicles or ships. Due to the lighter weight of the container of the present invention, fuel consumption during transportation can be reduced by more than 12%. For a long time, containers on the market have mainly been made of metal materials. There are no containers with AFRP, BS or wood as the main stress components in the existing market. The present invention is the first attempt, aiming to utilize the excellent properties of AFRP, BS or wood to develop a container that can be used for large-volume containers, providing a high-performance, environmentally friendly and economical container solution for cargo transportation.

[0030] Reliable strength: The specially processed BS has excellent mechanical properties such as tensile strength and compressive strength. Through scientific and reasonable frame structure design and reliable connection methods, the 40-foot BS container of the present invention can fully meet various strength requirements of international container standards. In practical use, whether it is the stacking of goods, vibration during transportation, or stress during hoisting operations, the container can stably bear loads, effectively ensuring the safety of goods during transportation. AFRP effectively improves the mechanical properties of connectors and composite components, and at the same time effectively enhances the corrosion resistance and durability of connectors and composite components, so that key stress components can maintain a long service life in the marine environment.

[0031] Excellent corrosion resistance: BS itself has certain corrosion resistance, and coupled with surface protective coatings and sealing treatments, its corrosion resistance in harsh environments is far superior to that of steel containers. In the humid and high-salt spray environment of marine transportation, general 40-foot steel containers need large-scale anti-corrosion maintenance work after 3-5 years of use, including derusting, repainting, etc., and each

maintenance cost is high. However, the 40-foot BS/wood frame container of the present invention, relying on its excellent corrosion resistance, has a service life of 8-10 years without large-scale anti-corrosion treatment, and the maintenance cost can be reduced by more than 50%. This not only reduces the investment of manpower, material resources and financial resources required for maintenance, but also greatly improves the use efficiency of the container and reduces the downtime caused by maintenance.

[0032] Environmentally friendly and sustainable: Bamboo grows extremely fast, reaching 10-20 meters in 3-4 months, and is a high-quality resource that can be used sustainably. The use of BS to make 40-foot containers can significantly reduce the dependence on non-sustainable resources such as steel. The production of steel not only consumes a lot of natural resources such as iron ore and coal, but also produces a lot of greenhouse gases such as carbon dioxide. In contrast, bamboo can absorb a large amount of carbon dioxide during its growth, playing a role in carbon sequestration, and its carbon emissions during processing are relatively low. Therefore, promoting the use of 40-foot BS containers is conducive to promoting the development of the container industry towards low-carbon and environmental protection, conforms to the global trend of sustainable development, and is of great significance to environmental protection.

DESCRIPTION OF THE DRAWINGS

[0033] FIG. 1 is a structural schematic diagram of the multifunctional container of the present invention.

[0034] FIG. 2 is a structural schematic diagram of the AFRP-steel-BS/wood frame structure of the present invention.

[0035] FIG. 3 is another structural schematic diagram of the AFRP-steel-BS/wood frame structure of the present invention.

[0036] FIG. 4 is a structural schematic diagram of the top AFRP-steel-corner fittings connector of the present invention.

[0037] FIG. 5 is a structural schematic diagram of the bottom AFRP-steel-corner fittings connector of the present invention.

[0038] Figure labels: 1 denotes AFRP-BS/wood corner post. 1-1 denotes first AFRP-BS/wood corner post. 1-2 denotes second AFRP-BS/wood corner post. 2 denotes AFRP-BS/wood middle column. 2-1 denotes first AFRP-BS/wood middle column. 2-2 denotes second AFRP-BS/wood middle column. 2-3 denotes third AFRP-BS/wood middle column. 3 denotes AFRP-BS/wood or steel longitudinal bottom edge beam. 3-1 denotes first AFRP-BS/wood or steel longitudinal bottom edge beam. 3-2 denotes second AFRP-BS/wood or steel longitudinal bottom edge beam. 4 denotes AFRP-BS/wood longitudinal top edge beam. 4-1 denotes first AFRP-BS/wood longitudinal top edge beam. 4-2 denotes second AFRP-BS/wood longitudinal top edge beam. 5 denotes AFRP-BS/wood or steel transverse short beam. 5-1 denotes first bottom steel transverse short beam. 5-2 denotes second AFRP-BS/wood transverse short beam. 5-3 denotes third AFRP-BS/wood transverse short beam. 5-4 denotes fourth AFRP-BS/wood transverse short beam. 5-5 denotes fifth AFRP-BS/wood transverse short beam. 6 denotes bottom AFRP-BS/wood middle longitudinal short beam. 7 denotes AFRP-BS/wood diagonal brace. 8 denotes AFRP-steel-corner fittings connector. 8-1 denotes top AFRP-steel-corner fittings connector. 8-2 denotes bottom AFRP-steel-corner fittings connector. 9 denotes AFRP-steel sleeve connector. 9-1 denotes first AFRP-steel sleeve connector. 9-2 denotes second AFRP-steel sleeve connector. 9-3 denotes third AFRP-steel sleeve connector. 9-4 denotes fourth AFRP-steel sleeve connector. 10 denotes AFRP-steel connector. 10-1 denotes first AFRP-steel connector. 10-2 denotes second AFRP-steel connector. 10-3 denotes third AFRP-steel connector. 11 denotes diagonal "T"-shaped AFRP-steel connector. 13 denotes door. 13-1 denotes end door. 13-2 denotes top door. 13-3 denotes side door. 14 denotes BS bottom slab. 15 denotes BS top slab. 16 denotes BS longitudinal side slab. 17 denotes BS transverse side slab.

DETAILED DESCRIPTIONS OF THE EMBODIMENTS

[0039] The technical solution of the present invention will be further described below with reference to the accompanying drawings.

[0040] Embodiment 1

5 [0041] The present invention discloses a multifunctional BS or wood container, as shown in FIGs. 1-5, which is composed of an AFRP-steel-BS/wood frame structure with anti-corrosion, anti-mildew and anti-ultraviolet coatings on the surface, and an enclosure structure. The AFRP-steel-BS/wood frame structure consists of AFRP-BS/wood corner posts 1, AFRP-BS/wood corner post middle columns 2, AFRP-BS/wood or steel longitudinal bottom edge beams 3, AFRP-10 BS/wood longitudinal top edge beams 4, AFRP-BS/wood or steel transverse short beams 5, bottom AFRP-BS/wood middle longitudinal short beams 6 and AFRP-BS/wood diagonal braces 7. Moreover, the AFRP-steel-BS/wood frame structure is connected via AFRP-steel-corner fittings connectors 8, AFRP-steel sleeve connectors 9, AFRP-steel connectors 10 and diagonal "T"-shaped AFRP-steel connectors 11. The AFRP-BS/wood or steel longitudinal bottom edge beams 3 and 15 AFRP-BS/wood longitudinal top edge beams 4 are integrally press-formed and arranged in a full-length manner. Both ends of the first bottom steel transverse short beams 5-1, which serve as the bottom edge beams of the AFRP-steel-BS/wood frame structure among the AFRP-BS/wood or steel transverse short beams 5, are provided with a "Men"-shaped (portal-shaped with two vertical supports and one horizontal top beam) structure. The enclosure structure includes doors 13, 20 BS/wood bottom slabs 14, BS/wood top slabs 15, BS/wood longitudinal side slabs 16 and BS/wood transverse side slabs 17, and the enclosure structure is installed on the periphery of the AFRP-steel-BS/wood frame structure.

[0042] The AFRP-steel-BS/wood frame structure is a rectangular three-dimensional structure. The AFRP-steel-corner fittings connectors 8 include four top AFRP-steel-corner fittings connectors 8-1 respectively located at the four corners of the top of the rectangular three-25 dimensional structure and four bottom AFRP-steel-corner fittings connectors 8-2 respectively

located at the four corners of the bottom of the rectangular three-dimensional structure. The AFRP-BS/wood corner posts 1 include two first AFRP-BS/wood corner posts 1-1 located at one port of the rectangular three-dimensional structure and two second AFRP-BS/wood corner posts 1-2 located at the other port of the rectangular three-dimensional structure. The first AFRP-BS/wood corner posts 1-1 and the second AFRP-BS/wood corner posts 1-2 are respectively fixedly installed between the top AFRP-steel-corner fittings connectors 8-1 and the bottom AFRP-steel-corner fittings connectors 8-2 that are located on the same straight line via AFRP-steel sleeve connectors 9. As shown in FIGs. 2 and 3, the top of the AFRP-BS/wood corner post 1 is connected to the top AFRP-steel-corner fittings connector 8-1 via the first AFRP-steel sleeve connector 9-1, and the bottom of the AFRP-BS/wood corner post 1 is connected to the bottom AFRP-steel-corner fittings connector 8-2 via the second AFRP-steel sleeve connector 9-2. The AFRP-BS/wood or steel transverse short beams 5 include first bottom steel transverse short beams 5-1, second AFRP-BS/wood transverse short beams 5-2, third AFRP-BS/wood transverse short beams 5-3, fourth AFRP-BS/wood transverse short beams 5-4 and fifth AFRP-BS/wood transverse short beams 5-5. The first bottom steel transverse short beams 5-1 are located at the short sides of the bottom rectangle of the rectangular three-dimensional structure and fixedly installed between two adjacent bottom AFRP-steel-corner fittings connectors 8-2. The second AFRP-BS/wood transverse short beams 5-2 are on the same side as the two first AFRP-BS/wood corner posts 1-1, and the second AFRP-BS/wood transverse short beams 5-2 are fixedly installed between the two top AFRP-steel-corner fittings connectors 8-1. The third AFRP-BS/wood transverse short beams 5-3 are on the same side as the two second AFRP-BS/wood corner posts 1-2, and the third AFRP-BS/wood transverse short beams 5-3 are fixedly installed between the two top AFRP-steel-corner fittings connectors 8-1. The AFRP-BS/wood or steel longitudinal bottom edge beams 3 are located at the long sides of the bottom rectangle of the rectangular three-dimensional structure and fixedly installed between two adjacent bottom AFRP-steel-corner fittings connectors 8-2. The AFRP-BS/wood longitudinal top edge beams 4 are located at the long sides of the top rectangle of the

rectangular three-dimensional structure and fixedly installed between two adjacent top AFRP-steel-corner fittings connectors 8-1. As shown in FIGs. 2 and 3, the AFRP-BS/wood longitudinal top edge beams 4 and the AFRP-BS/wood or steel longitudinal bottom edge beams 3 are connected to the corresponding AFRP-steel-corner fittings connectors 8 via third AFRP-steel connectors 10-3. The fourth AFRP-BS/wood transverse short beams 5-4 are fixedly installed between the two AFRP-BS/wood longitudinal top edge beams 4 at intervals not exceeding 1.5 meters along the longitudinal direction. The fifth AFRP-BS/wood transverse short beams 5-5 are fixedly installed between the two AFRP-BS/wood or steel longitudinal bottom edge beams 3 at intervals not exceeding 1.5 meters along the longitudinal direction.

[0043] As shown in FIG. 2, the bottom AFRP-BS/wood middle longitudinal short beams 6 are located at the center of the bottom rectangle of the rectangular three-dimensional structure, and both ends of the bottom AFRP-BS/wood middle longitudinal short beams 6 are fixedly connected to the adjacent first bottom steel transverse short beams 5-1 and fifth AFRP-BS/wood transverse short beams 5-5 or to two adjacent fifth AFRP-BS/wood transverse short beams 5-5. And the bottom AFRP-BS/wood middle longitudinal short beams 6 are connected to the first bottom steel transverse short beams 5-1 or the fifth AFRP-BS/wood transverse short beams 5-5 via first AFRP-steel connectors 10-1.

[0044] As shown in FIGs. 2 and 3, a plurality of AFRP-BS/wood corner post middle columns 2 are provided. Some of the AFRP-BS/wood corner post middle columns 2 are fixedly installed between the AFRP-BS/wood or steel longitudinal bottom edge beams 3 and AFRP-BS/wood longitudinal top edge beams 4 located in the same vertical plane via second AFRP-steel connectors 10-2, and the remaining AFRP-BS/wood corner post middle columns 2 are fixedly installed between the first bottom steel transverse short beams 5-1 and third bottom steel transverse short beams 5-3 via second AFRP-steel connectors 10-2.

[0045] AFRP-BS/wood diagonal braces 7 are respectively installed between the AFRP-BS/wood corner posts 1 and AFRP-BS/wood or steel longitudinal bottom edge beams 3, between

the AFRP-BS/wood middle columns 2 and AFRP-BS/wood or steel longitudinal bottom edge beams 3, between the AFRP-BS/wood longitudinal top edge beams 4 and first AFRP-BS/wood corner posts 1-1, between the AFRP-BS/wood longitudinal top edge beams 4 and second AFRP-BS/wood transverse short beams 5-2, between the second AFRP-BS/wood corner posts 1-2 and AFRP-BS/wood longitudinal top edge beams 4, and between the second AFRP-BS/wood corner posts 1-2 and third AFRP-BS/wood transverse short beams 5-3 via diagonal "T"-shaped AFRP-steel connectors 11. Two adjacent AFRP-BS/wood diagonal braces 7 connected to the AFRP-BS/wood or steel longitudinal bottom edge beams 3 are in an inverted "V"-shaped.

[0046] The BS/wood bottom slabs 14 are installed on the inner side of the bottom of the AFRP-steel-BS/wood frame structure, and the BS/wood top slabs 15, BS/wood longitudinal side slabs 16 and BS/wood transverse side slabs 17 are installed on the outer side of the AFRP-steel-BS/wood frame structure.

[0047] As shown in FIG. 1, the door 13 includes an end door 13-1, a top door 13-2 and side doors 13-3. The end door 13-1 is installed between the two first AFRP-BS/wood corner posts 1-1. The top door 13-2 is installed in the middle of the top of the AFRP-steel-BS/wood frame structure. The side door 13-3 is installed on the side of the AFRP-steel-BS/wood frame structure. In this embodiment, multiple side doors are installed, and as shown in FIG. 1, there are three side doors in total: side door 13-3, side door 13-4 and side door 13-5.

[0048] The door 13 can be provided at one, two or three positions among the top, side, and end of the AFRP-steel-BS/wood frame structure. Preferably, the door 13 can be made of metal, or one or a combination of multiple materials among bamboo glulam, BS, bamboo woven glued materials, bamboo-plastic composite materials, bamboo particle composite materials, bamboo scrap profiles, wood, and straw.

[0049] Preferably, the multifunctional BS or wood container of the present invention can be used as a mobile house.

[0050] The quantity and arrangement of each component of the AFRP-steel-BS/wood frame

structure of the present invention can be increased or decreased according to the weight tolerance and service conditions. The AFRP-BS/wood or steel longitudinal bottom edge beams 3 and AFRP-BS/wood longitudinal top edge beams 4 can be arranged in a full-length manner by one-time press forming as shown in FIG. 3, or formed by splicing two or more pieces as shown in FIG. 2, but the connection must be reliable. As shown in FIG. 2, the AFRP-BS/wood or steel longitudinal bottom edge beam 3 includes a first AFRP-BS/wood or steel longitudinal bottom edge beam 3-1 and a second AFRP-BS/wood or steel longitudinal bottom edge beam 3-2, which are connected via a fourth AFRP-steel sleeve connector 9-4. The AFRP-BS/wood longitudinal top edge beam 4 includes a first AFRP-BS/wood longitudinal top edge beam 4-1 and a second AFRP-BS/wood longitudinal top edge beam 4-2, which are connected via a third AFRP-steel sleeve connector 9-3.

[0051] Preferably, the BS of the present invention can be replaced with one of bamboo glulam, bamboo woven glued materials, bamboo-plastic composite materials, bamboo particle composite materials, bamboo scrap profiles, wood, bamboo-wood composite materials and straw, or a combination of multiple materials among bamboo glulam, bamboo woven glued materials, bamboo-plastic composite materials, bamboo particle composite materials, bamboo scrap profiles, wood, bamboo-wood composite materials and straw.

[0052] Preferably, the AFRP of the present invention can be replaced with one of glass fiber, carbon fiber and basalt fiber, or a combination of multiple materials among glass fiber, carbon fiber, AFRP and basalt fiber, or no AFRP is used according to the service life requirements.

[0053] The invention utilizes BS, which is produced by splitting bamboo into bamboo strips or separating it into full-length bamboo bundles that maintain the original fiber arrangement, or into loose reticulated bamboo fiber bundles with organic matter removed, or pure fibers, followed by processing (such as carbonization), drying, adhesive application, assembly, and pressing to form bamboo-based profiles. Bamboo scrimber benefits from a wide range of raw material sources and is not constrained by the original bamboo diameter; existing technologies have also achieved a certain degree of automated production. With its excellent mechanical properties, bamboo

scrimber demonstrates promising application prospects in structural systems. Currently, there are no shipping containers in the market that employ bamboo scrimber or wood as primary load-bearing members. The present invention aims to leverage the superior characteristics of bamboo scrimber or wood to develop a container suitable for ultra-long configurations, thereby providing a high-performance, environmentally friendly, and economical shipping container solution for cargo transportation.

[0054] The present invention fully utilizes the advantages of BS such as light weight, high strength, corrosion resistance and environmental protection, and effectively solves the problems of traditional steel containers such as heavy weight, easy corrosion, and large resource consumption. Through innovative design and manufacturing processes, it reduces transportation costs, improves the service life of containers, promotes the development of the container industry towards green and sustainable direction, and provides more efficient, reliable, and environmentally friendly solutions for cargo transportation.

[0055] Embodiment 2

[0056] The present invention discloses a preparation method for a multifunctional BS or wood container, comprising the following steps:

[0057] Step 1: Prepare AFRP-steel-corner fittings connectors 8. The AFRP-steel-corner fittings connectors 8 are formed by integrally combining corner fittings, AFRP-steel sleeves, AFRP-"Gong"-shaped (I-shaped with upper and lower horizontal segments) steel, and AFRP-steel plates.

The corner fitting is a cubic hollow component, with three mutually adjacent faces provided with holes for fixed connection during loading and unloading of the container. The other three non-porous faces are respectively welded with steel sleeves, "Gong"-shaped steel, or end beams. The centroid of the steel sleeve and the centroid of the corner fitting are on the same straight line, or the horizontal projection distance between the two centroids is less than one-fifth of the length of the short side of the steel sleeve. The surface layers of the steel sleeves, "Gong"-shaped steel or end beams are wrapped with AFRP. Prepare AFRP-steel sleeve connectors 9, AFRP-steel

connectors 10 and diagonal "T"-shaped AFRP-steel connectors 11, and wrap AFRP on the surface layers of the steel materials of AFRP-steel sleeve connectors 9, AFRP-steel connectors 10 and diagonal "T"-shaped AFRP-steel connectors 11. manufacture BS/wood components required for the AFRP-steel-BS/wood frame structure and the enclosure structure, and wrap AFRP on the outer surfaces of the components. The externally wrapped AFRP not only improves the mechanical properties of the connectors or components, but also enhances the durability of the connectors or components.

[0058] Step 2: Assemble the AFRP-steel-BS/wood frame structure. Connect AFRP-BS/wood or steel longitudinal bottom edge beams 3, first bottom steel transverse short beams 5-1 and AFRP-BS/wood corner posts 1 by using bottom AFRP-steel-corner fittings connectors 8-2. Connect AFRP-BS/wood longitudinal top edge beams 4, second AFRP-BS/wood transverse short beams 5-2, third AFRP-BS/wood transverse short beams 5-3 and AFRP-BS/wood corner posts 1 by using top AFRP-steel-corner fittings connectors 8-1. Connect the two AFRP-BS/wood or steel longitudinal bottom edge beams 3 by using fifth AFRP-BS/wood transverse short beams 5-5 at intervals not exceeding 1.5 meters along the longitudinal direction. Connect the first bottom steel transverse short beams 5-1 and the fifth AFRP-BS/wood transverse short beams 5-5 pairwise along the midpoint by using bottom AFRP-BS/wood middle longitudinal short beams 6. Connect the two AFRP-BS/wood longitudinal top edge beams 4 by using fourth AFRP-BS/wood transverse short beams 5-4 at intervals not exceeding 1.5 meters along the longitudinal direction. Connect AFRP-BS/wood middle columns 2 with AFRP-BS/wood or steel longitudinal bottom edge beams 3 and AFRP-BS/wood longitudinal top edge beams 4 or third AFRP-BS/wood transverse short beams 5-3 by using second AFRP-steel connectors 10-2. Connect AFRP-BS/wood middle columns 2, AFRP-BS/wood corner posts 1 with AFRP-BS/wood or steel longitudinal bottom edge beams 3 by using two AFRP-BS/wood diagonal braces 7 in an inverted "V"-shaped. Connect AFRP-BS/wood longitudinal top edge beams 4 with first AFRP-BS/wood corner posts 1-1 and second AFRP-BS/wood transverse short beams 5-2 by using AFRP-BS/wood diagonal braces 7. Connect

second AFRP-BS/wood corner posts 1-2 with AFRP-BS/wood longitudinal top edge beams 4 and third AFRP-BS/wood transverse short beams 5-3 by using AFRP-BS/wood diagonal braces 7.

[0059] Step 3: Install BS/wood bottom slabs 14 on the inner side of the AFRP-steel-BS/wood frame structure, and install BS/wood top slabs 15, BS/wood longitudinal side slabs 16 and BS/wood transverse side slabs 17 on the outer side of the AFRP-steel-BS/wood frame structure. Install end doors 13-1 between the first AFRP-BS/wood corner posts 1-1, and install top doors 13-2 at the middle position of the top of the AFRP-steel-BS/wood frame structure. Install side doors 13-3 on the side of the AFRP-steel-BS/wood frame structure. Perform anti-corrosion, anti-mildew and anti-ultraviolet treatment on the container enclosure structure.

[0060] Step 4: Treat the surface of the BS plates with a flexible water-based organosilicon superhydrophobic and antifouling coating. The coating is cross-linked through hydrosilylation reaction with high molecular weight divinyl-terminated polydimethylsiloxane (ViPDMSVi) and methyl vinyl MQ resin (MVMQ-resin) as raw materials, and polyether-modified organosilicon (D(PDMS)PE) and sodium dodecyl sulfate (SDS) as composite emulsifiers. The static water contact angle (WCA) of the coating is $\geq 150^\circ$, the sliding angle (SA) is $\leq 10^\circ$, and the coating can form a superhydrophobic interface. The tensile strength of the coating is $\geq 3.5\text{MPa}$, the elongation at break is $\geq 214\%$, and the coating can adapt to the dry-wet deformation of bamboo. The impedance radius of the coating in 3.5% NaCl solution is $\geq 1.2 \times 10^9 \Omega \cdot \text{cm}^2$, and the inhibition rate of the coating against Staphylococcus aureus is $\geq 99\%$.

[0061] The above embodiments are only specific implementations of the present invention, and the protection scope of the present invention is not limited thereto. Any equivalent transformations, improvements, etc. made based on the concept of the present invention without departing from the essence of the technical solution of the present invention shall be covered within the protection scope of the present invention.

CLAIMS

WHAT IS CLAIMED IS:

1. A multifunctional BS or wood container, comprising: the multifunctional container is composed of an AFRP-steel-BS/wood frame structure with anti-corrosion, anti-mildew and anti-ultraviolet coatings on the surface, and an enclosure structure. The AFRP-steel-BS/wood frame structure consists of AFRP-BS/wood corner posts 1, AFRP-BS/wood corner post middle columns 2, AFRP-BS/wood or steel longitudinal bottom edge beams 3, AFRP-BS/wood longitudinal top edge beams 4, AFRP-BS/wood or steel transverse short beams 5, bottom AFRP-BS/wood middle longitudinal short beams 6 and AFRP-BS/wood diagonal braces 7. Moreover, the AFRP-steel-BS/wood frame structure is connected via AFRP-steel-corner fittings connectors 8, AFRP-steel sleeve connectors 9, AFRP-steel connectors 10 and diagonal "T"-shaped AFRP-steel connectors 11. The AFRP-BS/wood or steel longitudinal bottom edge beams 3 and AFRP-BS/wood longitudinal top edge beams 4 are integrally press-formed and arranged in a full-length manner. Both ends of the first bottom steel transverse short beams 5-1, which serve as the bottom edge beams of the AFRP-steel-BS/wood frame structure among the AFRP-BS/wood or steel transverse short beams 5, are provided with a "Men"-shaped portal-shaped with two vertical supports and one horizontal top beam structure. The enclosure structure includes doors 13, BS/wood bottom slabs 14, BS/wood top slabs 15, BS/wood longitudinal side slabs 16 and BS/wood transverse side slabs 17, and the enclosure structure is installed on the periphery of the AFRP-steel-BS/wood frame structure.

2. The multifunctional BS or wood container according to claim 1, comprising: the AFRP-steel-BS/wood frame structure is a rectangular three-dimensional structure. The AFRP-steel-corner fittings connectors 8 include four top AFRP-steel-corner fittings connectors 8-1 respectively located at the four corners of the top of the rectangular three-dimensional structure and four bottom AFRP-steel-corner fittings connectors 8-2 respectively located at the four corners of the bottom of the rectangular three-dimensional structure. The AFRP-BS/wood corner posts 1

include two first AFRP-BS/wood corner posts 1-1 located at one port of the rectangular three-dimensional structure and two second AFRP-BS/wood corner posts 1-2 located at the other port of the rectangular three-dimensional structure. The first AFRP-BS/wood corner posts 1-1 and the second AFRP-BS/wood corner posts 1-2 are respectively fixedly installed between the top AFRP-steel-corner fittings connectors 8-1 and the bottom AFRP-steel-corner fittings connectors 8-2 that are located on the same straight line via AFRP-steel sleeve connectors 9. The AFRP-BS/wood or steel transverse short beams 5 include first bottom steel transverse short beams 5-1, second AFRP-BS/wood transverse short beams 5-2, third AFRP-BS/wood transverse short beams 5-3, fourth AFRP-BS/wood transverse short beams 5-4 and fifth AFRP-BS/wood transverse short beams 5-5.

The first bottom steel transverse short beams 5-1 are located at the short sides of the bottom rectangle of the rectangular three-dimensional structure and fixedly installed between two adjacent bottom AFRP-steel-corner fittings connectors 8-2. The second AFRP-BS/wood transverse short beams 5-2 are on the same side as the two first AFRP-BS/wood corner posts 1-1, and the second AFRP-BS/wood transverse short beams 5-2 are fixedly installed between the two top AFRP-steel-corner fittings connectors 8-1. The third AFRP-BS/wood transverse short beams 5-3 are on the same side as the two second AFRP-BS/wood corner posts 1-2, and the third AFRP-BS/wood transverse short beams 5-3 are fixedly installed between the two top AFRP-steel-corner fittings connectors 8-1. The AFRP-BS/wood or steel longitudinal bottom edge beams 3 are located at the long sides of the bottom rectangle of the rectangular three-dimensional structure and fixedly installed between two adjacent bottom AFRP-steel-corner fittings connectors 8-2. The AFRP-BS/wood longitudinal top edge beams 4 are located at the long sides of the top rectangle of the rectangular three-dimensional structure and fixedly installed between two adjacent top AFRP-steel-corner fittings connectors 8-1. The fourth AFRP-BS/wood transverse short beams 5-4 are fixedly installed between the two AFRP-BS/wood longitudinal top edge beams 4 at intervals not exceeding 1.5 meters along the longitudinal direction. The fifth AFRP-BS/wood transverse short beams 5-5 are fixedly installed between the two AFRP-BS/wood or steel longitudinal bottom edge

beams 3 at intervals not exceeding 1.5 meters along the longitudinal direction.

3. The multifunctional BS or wood container according to claim 2, comprising: the bottom AFRP-BS/wood middle longitudinal short beams 6 are located at the center of the bottom rectangle of the rectangular three-dimensional structure, and both ends of the bottom AFRP-BS/wood middle longitudinal short beams 6 are fixedly connected to the adjacent first bottom steel transverse short beams 5-1 and fifth AFRP-BS/wood transverse short beams 5-5 or to two adjacent fifth AFRP-BS/wood transverse short beams 5-5.

4. The multifunctional BS or wood container according to claim 3, comprising: a plurality of AFRP-BS/wood corner post middle columns 2 are provided. Some of the AFRP-BS/wood corner post middle columns 2 are fixedly installed between the AFRP-BS/wood or steel longitudinal bottom edge beams 3 and AFRP-BS/wood longitudinal top edge beams 4 located in the same vertical plane via second AFRP-steel connectors 10-2, and the remaining AFRP-BS/wood corner post middle columns 2 are fixedly installed between the first bottom steel transverse short beams 5-1 and third bottom steel transverse short beams 5-3 via second AFRP-steel connectors 10-2.

5. The multifunctional BS or wood container according to claim 4, comprising: AFRP-BS/wood diagonal braces 7 are respectively installed between the AFRP-BS/wood corner posts 1 and AFRP-BS/wood or steel longitudinal bottom edge beams 3, between the AFRP-BS/wood middle columns 2 and AFRP-BS/wood or steel longitudinal bottom edge beams 3, between the AFRP-BS/wood longitudinal top edge beams 4 and first AFRP-BS/wood corner posts 1-1, between the AFRP-BS/wood longitudinal top edge beams 4 and second AFRP-BS/wood transverse short beams 5-2, between the second AFRP-BS/wood corner posts 1-2 and AFRP-BS/wood longitudinal top edge beams 4, and between the second AFRP-BS/wood corner posts 1-2 and third AFRP-BS/wood transverse short beams 5-3 via diagonal "T"-shaped AFRP-steel connectors 11. Two adjacent AFRP-BS/wood diagonal braces 7 connected to the AFRP-BS/wood or steel longitudinal bottom edge beams 3 are in an inverted "V"-shaped.

6. The multifunctional BS or wood container according to claim 5, comprising: the BS/wood

bottom slabs 14 are installed on the inner side of the bottom of the AFRP-steel-BS/wood frame structure, and the BS/wood top slabs 15, BS/wood longitudinal side slabs 16 and BS/wood transverse side slabs 17 are installed on the outer side of the AFRP-steel-BS/wood frame structure.

7. The multifunctional BS or wood container according to claim 6, comprising: the doors 13 include end doors 13-1, top doors 13-2 and side doors 13-3. The end doors 13-1 are installed between the two first AFRP-BS/wood corner posts 1-1, the top doors 13-2 are installed in the middle of the top of the AFRP-steel-BS/wood frame structure. The side doors 13-3 are installed on the side of the AFRP-steel-BS/wood frame structure.

8. The multifunctional BS or wood container according to claim 6, comprising: the doors 13 can be provided at one, two or three positions among the top, side, and end of the AFRP-steel-BS/wood frame structure.

9. The multifunctional BS or wood container according to claim 1, comprising: the multifunctional BS or wood container can be used as a mobile house.

10. The multifunctional BS or wood container according to claim 1, comprising: the doors 13 are made of metal materials, or one or a combination of multiple materials among bamboo glulam, BS, bamboo woven glued materials, bamboo-plastic composite materials, bamboo particle composite materials, bamboo scrap profiles, wood, and straw.

11. The multifunctional BS or wood container according to claim 1, comprising: the AFRP can be replaced with one of glass fiber, carbon fiber and basalt fiber, or a combination of multiple materials among glass fiber, carbon fiber, AFRP and basalt fiber, or no AFRP is used according to the service life requirements.

12. The multifunctional BS or wood container according to claim 1, comprising: the quantity and arrangement of each component of the AFRP-steel-BS/wood frame structure can be increased or decreased according to the weight tolerance and service conditions.

13. The multifunctional BS or wood container according to claim 1, comprising: the AFRP-BS/wood or steel longitudinal bottom edge beams 3 and AFRP-BS/wood longitudinal top edge

beams 4 can be formed by splicing two or more pieces, and the connection is reliable.

14. The multifunctional BS or wood container according to claim 1, comprising: the BS can be replaced with one of bamboo glulam, bamboo woven glued materials, bamboo-plastic composite materials, bamboo particle composite materials, bamboo scrap profiles, wood, bamboo-wood composite materials and straw, or a combination of multiple materials among BS, bamboo glulam, bamboo woven glued materials, bamboo-plastic composite materials, bamboo particle composite materials, bamboo scrap profiles, wood, bamboo-wood composite materials and straw.

15. A preparation method for a multifunctional BS or wood container, characterized by comprising the following steps:

Step 1: Prepare AFRP-steel-corner fittings connectors 8. The AFRP-steel-corner fittings connectors 8 are formed by integrally combining corner fittings, AFRP-steel sleeves, AFRP-"Gong"-shaped (I-shaped with upper and lower horizontal segments) steel, and AFRP-steel plates. The corner fitting is a cubic hollow component, with three mutually adjacent faces provided with holes for fixed connection during loading and unloading of the container. The other three non-porous faces are respectively welded with steel sleeves, "Gong"-shaped steel, or end beams. The centroid of the steel sleeve and the centroid of the corner fitting are on the same straight line, or the horizontal projection distance between the two centroids is less than one-fifth of the length of the short side of the steel sleeve. The surface layers of the steel sleeves, "Gong"-shaped steel or end beams are wrapped with AFRP. Prepare AFRP-steel sleeve connectors 9, AFRP-steel connectors 10 and diagonal "T"-shaped AFRP-steel connectors 11, and wrap AFRP on the surface layers of the steel materials of AFRP-steel sleeve connectors 9, AFRP-steel connectors 10 and diagonal "T"-shaped AFRP-steel connectors 11. manufacture BS/wood components required for the AFRP-steel-BS/wood frame structure and the enclosure structure, and wrap AFRP on the outer surfaces of the components.

Step 2: Assemble the AFRP-steel-BS/wood frame structure. Connect AFRP-BS/wood or steel longitudinal bottom edge beams 3, first bottom steel transverse short beams 5-1 and AFRP-

BS/wood corner posts 1 by using bottom AFRP-steel-corner fittings connectors 8-2. Connect AFRP-BS/wood longitudinal top edge beams 4, second AFRP-BS/wood transverse short beams 5-2, third AFRP-BS/wood transverse short beams 5-3 and AFRP-BS/wood corner posts 1 by using top AFRP-steel-corner fittings connectors 8-1. Connect the two AFRP-BS/wood or steel longitudinal bottom edge beams 3 by using fifth AFRP-BS/wood transverse short beams 5-5 at intervals not exceeding 1.5 meters along the longitudinal direction. Connect the first bottom steel transverse short beams 5-1 and the fifth AFRP-BS/wood transverse short beams 5-5 pairwise along the midpoint by using bottom AFRP-BS/wood middle longitudinal short beams 6. Connect the two AFRP-BS/wood longitudinal top edge beams 4 by using fourth AFRP-BS/wood transverse short beams 5-4 at intervals not exceeding 1.5 meters along the longitudinal direction. Connect AFRP-BS/wood middle columns 2 with AFRP-BS/wood or steel longitudinal bottom edge beams 3 and AFRP-BS/wood longitudinal top edge beams 4 or third AFRP-BS/wood transverse short beams 5-3 by using second AFRP-steel connectors 10-2. Connect AFRP-BS/wood middle columns 2, AFRP-BS/wood corner posts 1 with AFRP-BS/wood or steel longitudinal bottom edge beams 3 by using two AFRP-BS/wood diagonal braces 7 in an inverted "V"-shaped. Connect AFRP-BS/wood longitudinal top edge beams 4 with first AFRP-BS/wood corner posts 1-1 and second AFRP-BS/wood transverse short beams 5-2 by using AFRP-BS/wood diagonal braces 7. Connect second AFRP-BS/wood corner posts 1-2 with AFRP-BS/wood longitudinal top edge beams 4 and third AFRP-BS/wood transverse short beams 5-3 by using AFRP-BS/wood diagonal braces 7.

Step 3: Install BS/wood bottom slabs 14 on the inner side of the AFRP-steel-BS/wood frame structure, and install BS/wood top slabs 15, BS/wood longitudinal side slabs 16 and BS/wood transverse side slabs 17 on the outer side of the AFRP-steel-BS/wood frame structure. Install end doors 13-1 between the first AFRP-BS/wood corner posts 1-1, and install top doors 13-2 at the middle position of the top of the AFRP-steel-BS/wood frame structure. Install side doors 13-3 on the side of the AFRP-steel-BS/wood frame structure. Perform anti-corrosion, anti-mildew, and anti-ultraviolet treatment on the container enclosure structure.

Step 4: Treat the surface of the BS plates with a flexible water-based organosilicon superhydrophobic and antifouling coating. The coating is cross-linked through hydrosilylation reaction with high molecular weight divinyl-terminated polydimethylsiloxane (ViPDMSVi) and methyl vinyl MQ resin (MVMQ-resin) as raw materials, and polyether-modified organosilicon (D(PDMS)PE) and sodium dodecyl sulfate (SDS) as composite emulsifiers. The static water contact angle (WCA) of the coating is $\geq 150^\circ$, the sliding angle (SA) is $\leq 10^\circ$, and the coating can form a superhydrophobic interface. The tensile strength of the coating is $\geq 3.5\text{MPa}$, the elongation at break is $\geq 214\%$, and the coating can adapt to the dry-wet deformation of bamboo. The impedance radius of the coating in 3.5% NaCl solution is $\geq 1.2 \times 10^9 \Omega \cdot \text{cm}^2$, and the inhibition rate of the coating against *Staphylococcus aureus* is $\geq 99\%$.