

DESCRIPTION

TITLE OF THE INVENTION: OVERALL STRUCTURE OF MODULAR HOUSES, ASSEMBLY METHOD AND FIELD INSTALLATION METHOD

Technical Field

The present invention relates to the technical field of modular buildings, and particularly to an overall structure of modular houses, an assembly method and a field installation method.

Background

A modular house, also known as a container house or a mobile house, has the characteristics of quick construction, mobility, and reuse. The existing modular house generally adopts a container structure, including an end frame, beams and floors. After built in a factory, the modular houses are uniformly transported in the form of containers to a construction site for installation and fixation. However, the existing modular house mainly has the following defects: (1) poor flexibility; floors, window bodies, etc. cannot be rotated, and the modular houses can only be assembled and constructed, resulting in low installation speed and high transportation cost. (2) If a high-rise or super high-rise building is built, when a plurality of modular houses are stacked up and down, the load bearing capacity of the beams is weak. (3) When the upper and lower modular houses are hoisted and spliced, the upper modular house is not easy to quickly locate and connect with the lower modular house. (4) An air conditioner external unit needs field installation, which is time-consuming and laborious. (5) Curtains are generally arranged outside the glass, are non-resistant to wind, easy to damage and troublesome in customization, and occupy space. If the curtains are arranged inside the glass, it is easy to make the glass leak, and not easy to repair. (6) The prefabrication of the existing modular house in the factory mainly includes the production of modules such as wall panels, roofs, floor, doors and windows, and even addition of electric circuits, pipe arrangement and interior decoration, but the utilization rate of the space in the modular house is still low, resulting in increased transportation cost. During factory assembly, the modular houses cannot be selectively assembled according to different uses of the modular houses. (7) When the existing modular houses are transported, the modular houses can only be transported individually, and the bearing capacity is poor during of stacked

transportation. For example, a plurality of modular houses need to be stacked during sea transportation, resulting in insufficient strength of corner fittings and poor bearing capacity. (8) During the field construction of the existing modular houses, the movable floor is hoisted after recovered, and then turned over and opened after hoisted to a target position. However, this mode will make it time-consuming and laborious when the floor is lowered at high altitude, and the movable floor is easy to loosen in the lifting process, resulting in downward flipping, with high risk factor. (9) The existing mechanical penthouse is generally designed as a house structure, which is not in line with the size of the container, high in material transportation cost and slow in construction. Moreover, a solar panel is generally arranged separately from the mechanical penthouse, thereby occupying a large space.

To sum up, the present invention urgently needs to design a new mode of module frame house to solve the above technical problems.

Summary

The purpose of the present invention is to overcome the above defects in the prior art, so as to provide an overall structure of modular houses with high space utilization rate, strong flexibility, high transportation cost and simple assembly, an assembly method and a field installation method.

The technical solution of the present invention is as follows:

An overall structure of modular houses in the present invention comprises a module frame and a movable floor. The module frame comprises at least two end frames, a beam body arranged between the end frames and a fixed floor arranged at the bottom; and the movable floor is hinged with the fixed floor so that the movable floor can turn over along the fixed floor.

Further, the overall structure of the modular houses according to claim 1, wherein the end frames are hinged with a movable window, and the movable window is stored in the module frame during transportation, turned out during field installation and used together with the movable floor as a part of another space.

Further, the top of the module frame is provided with a ceiling group; a suspended ceiling group is arranged below the ceiling group; electromechanical equipment and pipelines are put between the ceiling group and the suspended ceiling group and are transported together with the modular house; and the fixed floor and/or the movable floor at the bottom of the upper module frame is connected with the ceiling group of the lower module frame located below by a connecting assembly.

Further, beam bars are prefabricated at both ends of the movable floor; reinforcing beam

bars are arranged below the beam bars; when a plurality of modular houses are stacked up and down, the ends of the beam bars are connected with a column of the end frame of the upper module frame and the ends of the reinforcing beam bars are connected with a column of the lower module frame; and the reinforcing beam bars are installed on site.

Further, the at least one end frame is provided with an external wall; a movable part for connecting an air conditioner external unit is arranged in a cavity of the external wall, and the air conditioner external unit can be selectively arranged in the cavity of the external wall or extended along the cavity of the external wall; when the modular houses are transported, the air conditioner external unit is arranged in the cavity of the external wall; and when installed on site, the air conditioner external unit extends along the cavity of the external wall.

Further, the external wall and/or the movable window is provided with hollow glass; a curtain is arranged in a cavity of the hollow glass; the hollow glass is provided with an access panel; an access seal plate is arranged at the access panel; and an inflatable core communicated with the cavity of the hollow glass is arranged in a gap between a window frame and the hollow glass.

Further, when the prefabricated modular house is transported, detachable corner fittings are installed at four corners of the front end frame and the rear end frame; when the modular house has the movable window, the movable window rotates into the module frame; when the modular house has the external wall and the air conditioner external unit, the air conditioner external unit is withdrawn into the cavity of the external wall; the movable floor is folded to a side part of the module frame to form a structure that conforms to container transportation standards for transportation; when a plurality of modular houses need to be stacked and transported, the fixed floor at the bottom of the upper module frame is connected with the ceiling group of the lower module frame located below in a factory; and the end frame of the upper module frame is connected with the end frame of the lower module frame; or when a plurality of modular houses are stacked for overseas transportation, the detachable corner fittings used are designed to be thickened structures.

An assembly method for modular houses, comprising the following steps:

module frame assembly and welding: assembling the end frames, the fixed floor and the beam body to form a module frame structure;

external wall assembly: for modular houses needing the external walls, installing the external wall outside the end frame, and/or installing other external walls on side surfaces of the module frame;

fire protection layer assembly: installing fire protection layers on the columns and cross

beams of the end frames;

suspended ceiling group assembly: for modular houses needing the ceilings, assembling the ceiling group on the top of the module frame;

electromechanical equipment assembly: assembling electromechanical equipment and pipelines inside the module frame, or selectively conducting assembly of the electromechanical equipment and the pipelines and internal wall assembly alternately;

interior assembly: for modular houses needing interior decoration, assembling sanitary ware and doors in the module frame;

movable window group assembly: for modular houses needing movable windows, installing the movable windows at the inner side of the end of the module frame, which can be turned out or withdrawn along the end frame;

ceiling group assembly: installing the ceiling group above the suspended ceiling group;

component loading: packing material that needs to be installed on site intensively and putting in the module frame;

movable floor assembly: hinging the movable floor and the fixed floor to form a flipping structure, and after the movable floor is withdrawn, forming a side plate of the module frame to form a complete modular house.

Further, when the modular house is a ladder mold, the suspended ceiling group assembly, the assembly of interior sanitary ware, the movable window group assembly and the movable floor assembly are not conducted; after the module frame assembly and welding, the external wall assembly and the fire protection layer assembly are conducted; after the fire protection layer assembly, the assembly of the electromechanical equipment and the pipelines is directly entered; after the assembly of the electromechanical equipment and the pipelines, the assembly of the doors is conducted; after the assembly of the doors, component loading is conducted; after the component loading, the ceiling group assembly is conducted; and then, waterproof measures are taken for packing and transportation.

A field installation method for modular houses, comprising the following steps:

removing the corner fittings when the corner fittings on the modular house are detachable structures;

after the modular house is hoisted to a target position, hoisting a next modular house, and spacing the next modular house and the placed modular house which share the movable floor that is turned to a horizontal position; and connecting and fixing the movable floor and two adjacent modular houses;

when the modular house has the movable window, rotating out the movable window as

an end bay window or a balcony window of the third modular house, and fixing the movable window;

when the modular house has the external wall and the air conditioner external unit, pushing out the air conditioner external unit;

stacking and fixing all modular houses, and communicating the electromechanical equipment and the pipelines inside each modular house;

after all the modular houses are built, installing a roof group and an equipment room module to form an overall structure.

Further, before the modular house is hoisted, the movable floor of the modular house is turned down at first to a horizontal position and then hoisted.

Further, both ends of the movable floor are prefabricated with the beam bars, and the movable floor is connected with the columns of the end frames of the adjacent modular houses through the beam bars; the reinforcing beam bars are arranged below the beam bars; when adjacent modular houses are stacked up and down, one end of the beam bars is connected with the column of the upper modular house and one end of the reinforcing beam bars is connected with the column of the lower modular house;

when adjacent modular houses are connected front to back, the columns of each modular house are aligned front to back and connected through threaded connectors into a whole to form a double-column structure;

when the equipment room module is installed on the roof group, at least one side of the equipment room module is provided with a functional bracket that can be folded; when the equipment room module is transported, the functional bracket is in a withdrawn state to conform to the container transportation standards; and during field installation, the functional bracket is in an unfolded state.

Further, a foundation pier is arranged between the modular house at the bottom layer and a foundation embedded part; the foundation pier adopts a composite structure; an upper layer has the same material as a body of the modular house, and a lower layer has the same material as the foundation embedded part.

The present invention has the following beneficial effects:

(1) By arranging the movable floor and the movable window, the container standards can be satisfied during transportation, and the modular houses can be transported together. During field installation, the movable floor and the movable window can be turned out as a part of another modular house. Compared with the splicing of the modular houses, the installation speed can be greatly increased and the transportation cost is reduced.

(2) The beam bars and the reinforcing beam bars can be stressed as a whole by adding the reinforcing beam bars on the basis of the original beam bars, so as to greatly improve the structural strength, which is especially suitable for high-rise or super high-rise buildings and has safe bearing capacity.

(3) By arranging the pin holes and the positioning pins on the flange plates of the columns for positioning, the upper modular house can be quickly installed in place, which increases the installation speed. The positioning pins can be removed after positioning.

(4) The air conditioner external unit is designed into a structure capable of internal arrangement and external arrangement, which can not only satisfy the transportation requirements and greatly improve the transportation efficiency, but also directly push out the air conditioner external unit for connection on site. There is no need to transport the air conditioner external unit additionally for field installation, which greatly simplifies the assembly steps and saves time and effort.

(5) By arranging the curtain in the cavity of the hollow glass, there is no need to occupy the space outside the glass, and the curtain can be installed along with the glass during installation, without additional operation, so the installation is convenient. The access panel and the access seal plate are arranged, which can repair the curtain while ensuring the thermal insulation and sealing of the glass. In combination with the inflatable cores, air leakage and condensation of the inner cavity of the glass can be prevented, which is especially suitable for the case of large space in the inner cavity of the hollow glass.

(6) When the modular house is prefabricated in the factory, components of other modular houses can be placed therein, such as movable window and movable floor, so as to make full use of the inner space of the modular house. Moreover, the material that needs to be installed on site is packed intensively and put in the module frame, which is equivalent to transporting only one modular house to realize the construction of two modular houses in the present invention when transporting two modular houses in the prior art. Moreover, the present invention can conduct different assembly for a side mold, a ladder mold, etc., and has strong flexibility and wide application range.

(7) By arranging the reinforcing corner fittings, the present invention is especially suitable for overseas transportation, greatly improves the stability of the modular houses when stacked by multiple layers, and is difficult to deform by pressing.

(8) During field construction, after the movable floor is firstly lowered to the horizontal position and fixedly connected with the fixed floor, the movable floor is hoisted. There is no need to lower the movable floor in high altitude operation, and there is no need to consider

whether the movable floor will loosen and turn over in the hoisting process, which greatly improves the safety factor and saves time and effort for field installation.

(9) By designing the roof equipment room module into a size that meets the container transportation standards, and arranging the folded functional bracket on the equipment room module, the functional bracket can be withdrawn in the transportation process, so that the functional bracket can be transported by sea and land along with the equipment room module, thereby reducing the transportation cost. When installed on site, the functional bracket can be placed directly on the roof, without additional construction like the traditional machine room, which greatly reduces the amount of field construction, and the functional bracket can be deployed to lay solar panels or dry clothes.

Description of Drawings

Fig. 1 is a structural schematic diagram of a module frame in embodiment 1 of the present invention;

Fig. 2 is a structural schematic diagram of an end frame in embodiment 1 of the present invention;

Fig. 3 is a structural schematic diagram of a pin hole arranged in a column in embodiment 1 of the present invention;

Fig. 4 is a structural schematic diagram of matching of a pin hole and a positioning pin in embodiment 1 of the present invention;

Fig. 5 is a split schematic diagram of a partial structure of a modular house in embodiment 1 of the present invention;

Fig. 6 is a structural schematic diagram of connection between a ceiling group and a floor in embodiment 1 of the present invention;

Fig. 7 is a structural schematic diagram of a connecting assembly in embodiment 1 shown in Fig. 6;

Fig. 8 is a structural schematic diagram of a child-mother groove of a ceiling group in embodiment 1 of the present invention;

Fig. 9 is a structural schematic diagram of connection between a beam bar and a reinforcing beam bar in embodiment 1 of the present invention;

Fig. 10 is a structural schematic diagram of connection between a movable floor and a fixed floor in embodiment 1 of the present invention;

Fig. 11 is a structural schematic diagram of assembly of a modular house in a factory in embodiment 1 of the present invention;

Fig. 12 is a structural schematic diagram of an air conditioner external unit arranged in a

cavity of an external wall in embodiment 2 of the present invention;

Fig. 13 is a structural schematic diagram of an air conditioner external unit pushed out of a cavity of an external wall in embodiment 2 of the present invention;

Fig. 14 is a structural schematic diagram of a cavity of hollow glass in embodiment 3 of the present invention;

Fig. 15 is a structural schematic diagram of a detachable corner fitting in embodiment 4 of the present invention;

Fig. 16 is a structural schematic diagram of transportation of a modular house in embodiment 4 of the present invention;

Fig. 17 is a structural schematic diagram of a thickened corner fitting in embodiment 4 of the present invention;

Fig. 18 is a structural schematic diagram of an equipment room module in embodiment 6 of the present invention;

Fig. 19 is a structural schematic diagram of connection of a modular house, a foundation pier and a foundation embedded part in embodiment 7 of the present invention;

Fig. 20 is a structural enlarged schematic diagram of part I in embodiment 7 shown in Fig. 19.

Figure Marking Explanation:

1. module frame; 2. movable floor; 3. ceiling group; 4. suspended ceiling group; 5. detachable corner fitting; 5'. thickened corner fitting; 6. movable window; 7. external wall; 8. hollow glass; 9. internal wall; 10. equipment room module;

11. end frame; 12. beam body; 13. fixed floor; 14. internal connecting rod; 15. foundation pier; 16. foundation embedded part; 21. floor connecting seat; 22. connecting plate; 23. rock wool layer; 15.diagonal brace; 21.beam bar; 22.reinforcing beam bar; 31.connecting assembly; 32. child-mother groove; 33. C-shaped side frame; 41. suspended ceiling plate; 42. suspended ceiling buckle plate; 43. suspended ceiling frame; 51. corner fitting seat; 52. corner fitting body; 61. window hinge; 71. air conditioner external unit; 72. external unit bracket; 73. air conditioner grille; 74. screw rod assembly; 81. curtain; 82. access seal plate; 83. inflatable core; 84. L-shaped piece; 101. functional bracket; 102. solar panel;

111. column; 112. upper cross beam; 113. lower cross beam; 114. flange plate; 115. hoisting hole; 116. connecting seat; 117. fire protection layer; 118. pin hole; 119. positioning pin; 151. pier body; 152. pier bottom plate; 311. ceiling seat; 312. ceiling connecting seat; 313. ceiling rod; 314. ceiling connecting plate.

Detailed Description

The present invention will be further described in detail below in combination with the drawings of description and specific embodiments.

Embodiment 1

As shown in Fig. 1: An overall structure of modular houses comprises a module frame 1 and a movable floor 2; the module frame 1 comprises two end frames 11, a beam body 12 arranged between the end frames and a fixed floor 13 arranged at the bottom; and the movable floor 2 is hinged with the fixed floor 13 so that the movable floor 2 can turn over along the fixed floor 13.

In the present embodiment, one side between the two end frames 11 is provided with a beam body 12, and one side provided with the movable floor is not provided with the beam body. For example, the beam body 12 is arranged on the upper part of one side of the two end frames, and the beam body is arranged at the inner side of the end frames to facilitate the external installation of an external wall. A plurality of internal connecting rods 14 arranged at intervals are arranged between the beam body 12 and the fixed floor 13. Diagonal braces 15 are arranged between the two end frames 11 and the upper beam body 12. One side of the fixed floor 13 at the bottom is directly prefabricated with the beam body, and the other side is connected with the movable slab 2 by hinges, so that the movable floor 2 can be turned over by 90° along the fixed floor, and can be used as the side wall of the module frame 1 by turning up, and as a bottom plate of another space by lowering to a horizontal position.

As shown in Fig. 2: In the present embodiment, the end frame 11 comprise two columns 111 and an upper cross beam 112 and a lower cross beam 113 connected between the columns; one column has a rectangular section shape and the other column has a square or quasi-square section shape. The upper surface and the lower surface of the column are provided with flange plates 114; the flange plates cover the surface of the column; and the threaded connection between the columns of the upper module frame and the lower module frame can be realized through the flange plates. Wherein for the flange plate with large area, a hole can be arranged in the middle. For example, the threaded holes on the flange plate are arranged around the outer edge of the flange plate, and the hole is arranged in the middle position of the flange plate so that a cut plate body can be used for other purposes to save the material. Two top sides of the upper cross beam 112 are provided with hoisting holes 115 to facilitate the hoisting of the modular house. Because the corner fittings in the present embodiment are preferably designed as detachable corner fittings 5 for use in transportation, and the corner fittings are removed during field construction, but the hoisting function cannot

be realized by removing the corner fittings, the hoisting holes 115 are arranged on the upper cross beam to realize the field hoisting of the modular house. Preferably, the structures of the hoisting holes 115 are the same as those of the hoisting holes on the corner fittings. The side surface and the end surface of the column are prefabricated with connecting seats 116 to facilitate the threaded connection with other members. In the present embodiment, the end frame 11 is a prefabricated structure, that is, the column, the cross beams, the flange plates and all connecting seats are prefabricated into a whole in the factory to form the end frame. In addition, the columns and the cross beams of the end frames are also provided with fire protection layers 117.

As shown in Fig. 3 and Fig. 4: The flange plate of the column is also provided with a pin hole 118. When the upper and lower modular houses are connected, the positioning pin 3 is connected into the pin hole 118 of the lower modular house. When the upper modular house is hoisted to the upper part of the lower modular house, the pin hole on the lower end surface of the column of the upper modular house penetrates through the positioning pin of the lower modular house to position the upper and lower modular houses. After the upper modular house is positioned, the positioning pin is taken out. Then, the columns of the upper and lower modular houses are fixed by threads through the flange plates 114. In addition, when the bottom modular house and the ground are positioned, the bottom surface of the column of the bottom modular house and the ground are also positioned through the positioning pins 119 and the pin holes 118 respectively. Through this positioning mode, the upper and lower modular houses can be quickly positioned and installed.

The modular houses in the present embodiment can be used as residential houses, ladder room molds, equipment room modules, etc. For example, when the modular houses are used as the ladder room molds, stairs and elevators can be arranged in the module frame; and when the modular houses are used as the equipment room modules, electrical equipment is arranged in the module frame, and the equipment room modules are placed on the roof. No matter what building the modular houses are used for, the container transportation standards can be satisfied for sea and land transportation, and field installation is the same as building blocks, which is convenient for transportation and installation and saves time and effort.

As shown in Fig. 5: In the present embodiment, the top of the module frame 1 is provided with a ceiling group 3; a suspended ceiling group 4 is arranged below the ceiling group 3; electromechanical equipment and pipelines, such as related equipment of wind, water and electricity, are put between the ceiling group 3 and the suspended ceiling group 4, and are transported together with the modular house, wherein the suspended ceiling group 4

comprises a suspended ceiling plate 41, a suspended ceiling buckle plate 42 and a suspended ceiling frame 43. The interior of the suspended ceiling frame 43 can be used to place a fresh air ventilator, an air conditioner and other equipment, and the ceiling group 3 is installed above the suspended ceiling frame.

As shown in Fig. 6 to Fig. 8: In the present embodiment, the fixed floor 13 at the bottom of the upper module frame is prefabricated and connected with the ceiling group 3 of the lower module frame located below in a factory for entire transportation or field installation; and the movable floor is lowered and connected with the ceiling group of the lower module frame located below by a connecting assembly 31 for field installation. Specifically, the ceiling group comprises a plurality of plate bodies spliced with each other; the long edges of adjacent plate bodies are designed into a child-mother groove structure; and after a child-mother groove 32 is clamped, fireproof sealing material is filled in the gap. The short side of each plate body of the ceiling group is provided with a C-shaped side frame 33. The connecting assembly 31 comprises a ceiling seat 311, a ceiling connecting seat 312, a ceiling rod 313 and a ceiling connecting plate 314. The ceiling seat 311 is connected with the movable floor 2 and can be prefabricated on the movable floor in advance. The ceiling connecting seat 312 is in threaded connection with the ceiling seat 311; the upper part of the ceiling rod 313 is connected with the ceiling connecting seat 312; and the lower end of the ceiling rod is connected with the ceiling connecting plate 314 and is in threaded connection with the C-shaped side frame 33 of the ceiling group of the lower modular house through the ceiling connecting plate 314. Because the ceiling group below the fixed floor 13 is arranged adjacent to the ceiling group below the movable floor 2, the ceiling connecting plate 314 can extend to the C-shaped side frame of the ceiling group below the fixed floor, so that the ceiling connecting plate 314 is in threaded connection with the two adjacent ceiling groups simultaneously, thereby greatly increasing the installation speed.

It is understood that the ceiling connecting plate of the present embodiment may also be designed as a ceiling hook through which the C-shaped side frame is directly hooked without the need for threaded connection. However, although this mode is faster to install, the connection stability is poorer than the threaded connection.

As shown in Fig. 9: In the present embodiment, beam bars 21 are prefabricated at both ends of the movable floor 2; reinforcing beam bars 22 are arranged below the beam bars 21; when a plurality of modular houses are stacked up and down and installed, for example, the movable floor of the upper module frame is lowered to a horizontal position, one end of the beam bars 21 is in threaded connection with a column 111 of the end frame of the upper

module frame through the connecting seat and the other ends of the beam bars 21 are connected with the column of another adjacent module frame; and the reinforcing beam bars 22 are installed on site. Both ends of the reinforcing beam bars 22 are in threaded connection with the column 111 of the adjacent lower module frame respectively, and the reinforcing beam bars 22 are also fixed with the beam bars 21 by bolts. Wherein nuts are embedded in the beam bars 21, and the bolts penetrate through the beam bars by the reinforcing beam bars 22 and are connected with the embedded nuts to form a whole to satisfy the overall stress requirements. It can be seen that the beam bars and the reinforcing beam bars can be stressed as a whole by adding the reinforcing beam bars on the basis of the original beam bars in the present embodiment, so as to greatly improve the structural strength, which is especially suitable for high-rise or super high-rise buildings.

In the present embodiment, the lower parts of the movable floor 2 and the fixed floor 13 are also prefabricated with joists. When the movable floor is turned over to be horizontal with the fixed floor, the joists of the two are abutted and fixedly connected.

As shown in Fig. 10: In the present embodiment, the movable floor 2 is lowered and then fixedly connected with fixed floor 13, that is, floor connecting seats 21 are arranged on the bottom surfaces of the movable floor 2 and the fixed floor 13 respectively, and a connecting plate 22 is shared between the two floor connecting seats. A bolt penetrates through the connecting plate and is connected with the floor connecting seat of the movable floor, and another bolt penetrates through the connecting plate and is connected with the floor connecting seat of the fixed floor to fix the two. The gap between the movable floor and the fixed floor is filled with a rock wool layer 23.

As shown in Fig. 11: In the present embodiment, a movable window 6 is also arranged in some modular houses, such as residential houses. The movable window 6 is connected with the column 111 of the end frame 11 through a window hinge 61, and one end of the window hinge 61 is connected with the inner side position of the column 111. The movable window 6 is stored in the module frame when transported, so that the modular house can be transported in accordance with the container standard. During field installation, the movable window is turned out and used together with the movable floor 2 as a part of another space. The movable window 6 can be a bay window or a balcony window, etc. For example, the bay window is hinged on one end frame and the balcony window is hinged on the other end frame. During field installation, the window is turned out and used as an end window on both ends of another space, to form a new modular house structure together with the movable floor 2.

In the present embodiment, at least one end frame 11 is provided with an external wall 7.

For example, the two end frames are provided with the external walls 7, or one end frame is provided with the external wall and the other end frame is directly provided with the balcony window. The external wall can also be provided with a window.

When the modular house of the present embodiment is prefabricated in the factory, wind, water and electric pipelines are prefabricated in the module frame in advance, such as water supply and drainage pipelines, oil smoke standpipes, sewage pipes, fresh air pipe groups, etc., and the bathroom hardware sanitary ware group is also prefabricated in advance, such as washbasin, toilet, shower basin, etc. It can be seen that the present invention prefabricates all the hard decoration, and when transported to the site for installation, the wind, water and electric pipelines between the upper floor and the lower floor only need to be connected. For modular houses needing internal walls, the internal walls 9 are prefabricated in the module frame in advance in the factory.

In the present embodiment, the fixed floor, the movable floor and the ceiling group all adopt metal core plates. The material of the core plates is preferably stainless steel or aluminum, including an upper panel, a lower panel and a sandwich layer champed therebetween. The sandwich layer comprises a plurality of hollow tube arrays in brazed connection with the panels, a plurality of hollow tubes are arranged at intervals, and thermal insulation layers are arranged in adjacent gaps. It is understood that the sandwich layer of the present invention can also be other spaced structures, such as corrugated cores.

A specific assembly method for modular houses in the factory in the present embodiment comprises the following steps:

Module frame assembly and welding: assembling the end frames 11, the fixed floor 13, the beam body 12 and internal connecting rods 14 to form a module frame structure, wherein each connecting seat on the end frames 11 and the connecting seat, beam bar and the joist on the fixed floor 13 are prefabricated on the body in advance, and only need to be assembled and welded on site. In addition, because the fixed floor and the movable floor are the core plate structures, the core plates need to be cut on front and rear sides when being cut. Because the core plate is not a single-layer plate, and the sandwich layer arranged in the middle has certain thickness, if the upper panel is directly cut to the lower panel, it is easy to cut inaccurately. Thus, after the front side of the panel is cut, the panel is turned to the rear side to cut the rear side of the panel. When the core plates are assembled and welded to form the floor, the front and rear sides also need to be welded.

External wall assembly: for modular houses needing the external walls, assembling the external walls, for example, installing the external walls 7 outside the end frame, and/or

installing the external walls on side surfaces onto a side of the beam body 12 of the module frame.

Fire protection layer assembly: installing fire protection layers 117 on the columns and the cross beams of the front end frame and the rear end frame, and wrapping the columns and the cross beams to improve fire resistance.

Suspended ceiling group assembly: for modular houses needing the ceilings, assembling the ceiling group 4 on the top of the module frame.

Electromechanical equipment assembly: assembling electromechanical equipment and pipelines inside the module frame, and selectively conducting assembly of the electromechanical equipment and the pipelines and assembly of the internal wall 9 alternately.

Interior assembly: for modular houses needing interior decoration, assembling the bathroom hardware sanitary ware group and doors in the module frame.

Movable window group assembly: for modular houses needing movable windows 6, installing the movable windows at the inner side of the end of the module frame, which can be turned out or withdrawn along the end frame.

Ceiling group assembly: installing the ceiling group 3 above the suspended ceiling group 4.

Component loading: packing material that needs to be installed on site intensively and putting in the module frame.

Movable floor assembly: hinging the movable floor 2 and the fixed floor 13 to form a flipping structure, and after the movable floor 2 is withdrawn, forming a side plate of the module frame 1 to form a complete modular house.

Wherein when the modular house is a ladder mold, the suspended ceiling group assembly, the assembly of interior sanitary ware, the movable window group assembly and the movable floor assembly may not be conducted; after the module frame assembly and welding, the external wall assembly and the fire protection layer assembly are conducted; after the fire protection layer assembly, the assembly of the electromechanical equipment and the pipelines is directly entered; after the assembly of the electromechanical equipment, the assembly of the doors is conducted; after the assembly of the doors, component loading is conducted; after the component loading, the ceiling group assembly is conducted; and then, waterproof measures are taken for packing and transportation.

In the present embodiment, when the modular house is assembled in the factory, the modular house comprises a structural section, an interior decoration section, a stowage

section, a movable plate section and a packing and delivery section along the final assembly direction of the modular house, and the production line of each section transfers the modular house from a first station to a last station jointly through a traction conveying system, to form a final modular house structure. For example, the structural section comprises at least three stations, which are used for assembling the end frames, the fixed floor, the beam body, etc., to form a preliminary module frame structure, so as to give priority to ensuring dimensional accuracy. The interior decoration section comprises at least six stations for the interior decoration of the module frame, mainly including the fire protection layers, ceilings, walls, doors and wind, water and electricity. All materials over 15 kg are hoisted with special hoists, and each module is moved to an appropriate position for positioning and installation. The stowing section comprises a stowing station. Materials that need to be installed on site are packed together and transferred to the installation site along with the modular house, such as internal wall doors, cabinets, and reinforcing beam bars that need to be installed on site. The movable plate section comprises a movable plate station for welding the movable floor and the fixed floor together by a hinge, turning by 90° by a semi-gantry crane, closing the mold and fixing. The packing and delivery section comprises a protecting coat station and a delivery station. The protecting coat station is used for completely wrapping the manufactured modular house with PVC coated tarpaulin and tightening with a nylon rope; and the delivery station is used for hoisting the finished modular house onto a truck for delivery to an installation site or a storage area.

Embodiment 2

As shown in Fig. 12 and Fig. 13: Based on embodiment 1, a movable part for connecting an air conditioner external unit 71 is arranged in a cavity of the external wall in the present embodiment, and the air conditioner external unit 71 can be selectively arranged in the cavity of the external wall or extended along the cavity of the external wall; when the modular houses are transported, the air conditioner external unit 71 is arranged in the cavity of the external wall; and when installed on site, the air conditioner external unit 71 extends along the cavity of the external wall.

Wherein the movable part is a detachable structure or a push-pull structure. When the movable part is a detachable structure, the movable part can be fixed and disassembled by a screw rod assembly 74. For example: The bottom of the air conditioner external unit 71 is provided with an external unit bracket 72, and the air conditioner external unit is in threaded fixation with the screw rod assembly in the cavity of the external wall through the external unit bracket 72. When a part of the air conditioner external unit is pushed out of the cavity of

the external wall, the air conditioner external unit is removed and pushed into an air conditioner grille 73 connected to the outside of the external wall. The air conditioner grille 73 is installed on site. The inner part of the external unit bracket 72 of the air conditioner external unit is connected and fixed with the screw rod assembly 74, and the outer part is fixed with the air conditioner grille through a connector. When the movable part is a push-pull structure, the movable part can be designed as a sliding rail structure, that is, there are two sliding rails in the cavity of the external wall. The sliding rails are connected with a push-pull plate, and the external unit bracket of the air conditioner external unit is fixed on the push-pull plate by bolts. The push-pull part is pushed out or withdrawn manually to achieve two states of internal arrangement or external arrangement of the air conditioner external unit.

Embodiment 3

As shown in Fig. 14: Based on embodiment 1, the external wall and/or the movable window is provided with hollow glass 8; a curtain 81 is arranged in a cavity of the hollow glass 8; the hollow glass is provided with an access panel; an access seal plate 82 is arranged at the access panel; and an inflatable core 83 communicated with the cavity of the hollow glass is arranged in a gap between a window frame and the hollow glass.

Specifically, two inflatable cores 83 communicated with the cavity of the hollow glass are arranged in the gap between the window frame and the hollow glass. The two inflatable cores are arranged up and down. One inflatable core is used for inflation and the other inflatable core is used for deflation, to form an inflating and deflating channel with the cavity of the hollow glass. The inflatable cores 83 are preferably valve cores, such as metal valve cores used in automobiles or motorcycles, which have small outer diameter dimensions, usually 3-6 mm, and do not occupy too much space. The two inflatable cores may be selected for inflation or deflation according to the density of the inert gas inflated. For example, argon is preferably inflated in the present embodiment. Because the density of the argon is greater than the density of air, the lower inflatable core is selected for inflation, and the upper inflatable core is selected for deflation.

The curtain 81 is arranged in the cavity of the hollow glass 8, so that there is no need to occupy the space outside the glass. The traditional hollow glass can be treated by a molecular sieve because of small inner cavity space. In the present embodiment, the curtain is arranged in the cavity of the glass, which causes a large space in the cavity of the glass and makes it difficult for the molecular sieve to treat the air leakage phenomenon, so the problem can be well solved by arranging the two inflatable cores.

To repair and maintain electric devices at the curtain in the wave or the curtain itself, in the present embodiment, the access panel is also arranged on the upper part of the hollow glass. The access panel is arranged between the inner glass (the side facing the interior) of the hollow glass 8 and the window frame. The access seal plate 82 is arranged at the access panel. The access seal plate 82 is designed as a thermal insulation structure which comprises thermal insulation cotton and an outer panel arranged at the periphery of the thermal insulation cotton. The outer panel is provided with a wrapping edge which can wrap the thermal insulation cotton. The lower end of the outer panel is hermetically connected with the inner glass of the hollow glass. An L-shaped piece 84 is arranged at the inner side. One end of the L-shaped piece 84 is glued to the wrapping edge of the outer panel, and the other end is glued and fixed with the inner wall of the inner glass. The upper end of the outer panel is hermetically connected with the window frame by a sealant and a sealing element. The upper inflatable core is connected with the access seal plate. The inflatable core 83 penetrates through the thermal insulation layer of the access seal plate 82 and is communicated with the cavity of the hollow glass 8, and welded and fixed with the outer panel to prevent shaking during inflation and deflation. When the curtain 81 needs to be repaired, the colloid can be cut off, and the access seal plate 82 can be removed for repair. The access seal plate is still sealed with the colloid after the repair, and the upper and lower two inflatable cores 83 are used for inflation and deflation again.

Embodiment 4

After the modular houses are packed and transported, the transportation method comprises:

(1) Installing detachable corner fittings 5 at four corner positions of the front end frame and the rear end frame, and specifically installing on the upper part position of the front end surface of the column. The detachable corner fitting 5 comprises a corner fitting seat 51 and a corner fitting body 52. The structure of the corner fitting body 52 is the same as the structure of the existing container standard corner fitting, and is in threaded fixation with the column 111 by the corner fitting seat 51. Moreover, the corner fitting body 52 extends horizontally along the corner fitting seat 51, and conforms to the container transportation standards, as shown in Fig. 15.

(2) When the modular house has the movable window, rotating the movable window into the module frame.

(3) When the modular house has the external wall and the air conditioner external unit, withdrawing the air conditioner external unit into the cavity of the external wall.

(4) Furling the movable floor to a side part of the module frame to form a structure that conforms to container transportation standards for transportation, with the transportation method as shown in Fig. 16.

It can be understood that when a plurality of modular houses need to be stacked and transported, the fixed floor at the bottom of the upper module frame is connected with the ceiling group of the lower module frame located below in a factory; and the end frame of the upper module frame is connected with the end frame of the lower module frame;

When a plurality of modular houses are stacked for overseas transportation, the detachable corner fittings used are designed to be thickened structures. Because more layers of modular houses need to be stacked for overseas transportation, in order to make the whole modular houses more stable and able to withstand greater acting forces, the corner fittings need to be thickened. Then, the thickness of the corner fitting seats designed by the thickened corner fittings 5' is greater than the thickness of the corner fitting seats of the detachable corner fittings, so as to increase the load borne by the corner fittings, as shown in Fig. 17.

Embodiment 5

Based on embodiment 4, after the modular houses are transported to the construction site, a field installation method for the modular houses specifically comprises the following steps:

(1) Removing four detachable corner fittings on the modular house.

(2) Hoisting the modular house, and before hoisting, turning down the movable floor of the modular house at first to a horizontal position and then hoisting. The purpose of the practice is: if the modular house is firstly hoisted to the target position and then lowered, on the one hand, especially for lowering in the position of a very high floor, due to the large weight of the movable floor, it is not only time-consuming and laborious but also prone to danger during lowering; and on the other hand, in the process of hoisting, if the movable floor is unstable in connection and has a downward turning action, it will also be dangerous. After comprehensive consideration, in the present embodiment, the movable floor is firstly lowered to the horizontal position and fixedly connected with the fixed floor, and then hoisted. After the modular house is hoisted to a target position, a next modular house is hoisted, and the next modular house and the placed modular house are spaced and share the movable floor that is turned to a horizontal position; and the movable floor and two adjacent modular houses are connected and fixed to form a third modular house. In addition, both ends of the movable floor are prefabricated with the beam bars, and the movable floor is connected with the columns of the end frames of the adjacent modular houses through the beam bars; the reinforcing beam bars are connected below the beam bars; when adjacent modular houses are

stacked up and down, one end of the beam bars is connected with the column of the upper adjacent modular house and one end of the reinforcing beam bars is connected with the column of the lower adjacent modular house.

(3) When the modular house has the movable window, rotating out the movable window as an end bay window or a balcony window of the third modular house, and fixing the movable window.

(4) When the modular house has the external wall and the air conditioner external unit, pushing out and fixing the air conditioner external unit.

(5) Installing the movable floor and the ceiling group of the lower modular house located below by a connecting assembly on site, and during field installation, only conducting threaded connection of the ceiling connecting plate of the prefabricated connecting assembly on the upper movable floor and the ceiling group of the lower modular house.

(6) Stacking and fixing all modular houses, and communicating the wind, water and electricity inside each modular house.

(7) In addition to stacking up and down, placing the modular houses horizontally, including left and right arrangement and front and back arrangement. For front and back arrangement, aligning the columns of the end frames of each modular house front to back and connecting through threaded connectors into a whole to form a double-column structure, which can greatly enhance the stability of the overall stress.

(8) After all the modular houses are built, installing a roof group and an equipment room module to form an overall structure. Wherein the equipment room module comprises a module frame, which can satisfy the container transportation standards, and the roof group is transported separately from the equipment room module.

Embodiment 6

As shown in Fig. 18: In the present embodiment, at least one side of the equipment room module 10 is provided with a functional bracket 101 that can be folded; when the equipment room module 10 is transported, the functional bracket 101 is in a withdrawn state to conform to the container transportation standards; and during field installation, the functional bracket 101 is in an unfolded state. Wherein the functional bracket 101 is hinged with the side surface of the machine room mode 10 and can be turned over within the range of 90°. Preferably, the functional bracket is used as a solar bracket, and a solar panel 102 is laid on the functional bracket to provide electrical energy for the electrical equipment in the equipment room module to save the electricity cost.

Embodiment 7

As shown in Fig. 19 and Fig. 20: In the present embodiment, a foundation pier 15 is arranged between the modular house at the bottom layer and a foundation embedded part 16; the foundation pier 15 adopts a composite structure; an upper layer has the same material as a body of the modular house, and a lower layer has the same material as the foundation embedded part 16.

Specifically, the foundation pier 15 comprises a pier body 151 and a pier bottom plate 152, and the pier body 151 is connected with the modular house. For example, the modular house of the present embodiment is made of stainless steel material. Then, the pier body is also made of stainless steel. The pier body and the modular house are fixed by a bolt group. The foundation embedded part 16 is arranged in underground concrete, and preferably made of carbon steel material. In order to effectively connect the stainless steel material and the carbon steel material, in the present embodiment, the pier bottom plate 152 is designed into a stainless steel-carbon steel composite plate, to form a double-layer structure. The upper layer structure is made of the stainless steel material, and welded with the pier body 151 into a whole. The lower structure is made of the carbon steel material, and welded with the foundation embedded part 16 into a whole. In this way, the modular house and the foundation embedded part are connected into a whole through the stainless steel-carbon steel composite plate. On the one hand, the cost of the foundation embedded part is greatly reduced. Because the cost is greatly increased if the foundation embedded part is made of the stainless steel, the cost problem is solved by the carbon steel. On the other hand, the stainless steel-carbon steel composite plate is not a matching structure of a stainless steel plate and a carbon steel plate, but a composite plate. There is no gap between the two layers of plates, so there is no corrosion, thereby greatly prolonging the service life.

The above only describes specific embodiments of the present application, but the protection scope of the present application is not limited thereto. Any change or replacement contemplated easily by those skilled in the art familiar with the technical field within the technical scope disclosed by the present application shall be covered within the protection scope of the present application. Therefore, the protection scope of the present application shall be determined by the protection scope of the claims.

CLAIMS

- Claim 1: An overall structure of modular houses, comprising a module frame and a movable floor, wherein the module frame comprises at least two end frames, a beam body arranged between the end frames and a fixed floor arranged at the bottom; and the movable floor is hinged with the fixed floor so that the movable floor can turn over along the fixed floor.
- Claim 2: The overall structure of the modular houses according to claim 1, wherein the end frames are hinged with a movable window, and the movable window is stored in the module frame during transportation, turned out during field installation and used together with the movable floor as a part of another space.
- Claim 3: The overall structure of the modular houses according to claim 1, wherein the top of the module frame is provided with a ceiling group; a suspended ceiling group is arranged below the ceiling group; electromechanical equipment and pipelines are put between the ceiling group and the suspended ceiling group and are transported together with the modular house; and the fixed floor and/or the movable floor at the bottom of the upper module frame is connected with the ceiling group of the lower module frame located below by a connecting assembly.
- Claim 4: The overall structure of the modular houses according to claim 1, wherein beam bars are prefabricated at both ends of the movable floor; reinforcing beam bars are arranged below the beam bars; when a plurality of modular houses are stacked up and down, the ends of the beam bars are connected with a column of the end frame of the upper module frame and the ends of the reinforcing beam bars are connected with a column of the lower module frame; and the reinforcing beam bars are installed on site.
- Claim 5: The overall structure of the modular houses according to claim 1, wherein the at least one end frame is provided with an external wall; a movable part for connecting an air conditioner external unit is arranged in a cavity of the external wall, and the air conditioner external unit can be selectively arranged

in the cavity of the external wall or extended along the cavity of the external wall; when the modular houses are transported, the air conditioner external unit is arranged in the cavity of the external wall; and when installed on site, the air conditioner external unit extends along the cavity of the external wall.

Claim 6: The overall structure of the modular houses according to claim 2 or 5, wherein the external wall and/or the movable window is provided with hollow glass; a curtain is arranged in a cavity of the hollow glass; the hollow glass is provided with an access panel; an access seal plate is arranged at the access panel; and an inflatable core communicated with the cavity of the hollow glass is arranged in a gap between a window frame and the hollow glass.

Claim 7: The overall structure of the modular houses according to claim 2 or 5, wherein when the prefabricated modular house is transported, detachable corner fittings are installed at four corners of the front end frame and the rear end frame; when the modular house has the movable window, the movable window rotates into the module frame; when the modular house has the external wall and the air conditioner external unit, the air conditioner external unit is withdrawn into the cavity of the external wall; the movable floor is folded to a side part of the module frame to form a structure that conforms to container transportation standards for transportation; when a plurality of modular houses need to be stacked and transported, the fixed floor at the bottom of the upper module frame is connected with the ceiling group of the lower module frame located below in a factory; and the end frame of the upper module frame is connected with the end frame of the lower module frame; or when a plurality of modular houses are stacked for overseas transportation, the detachable corner fittings used are designed to be thickened structures.

Claim 8: An assembly method for modular houses, comprising the following steps:
module frame assembly and welding: assembling the end frames, the fixed floor and the beam body to form a module frame structure;
external wall assembly: for modular houses needing the external walls, installing the external wall outside the end frame, and/or installing other

external walls on side surfaces of the module frame;

fire protection layer assembly: installing fire protection layers on the columns and cross beams of the end frames;

suspended ceiling group assembly: for modular houses needing the ceilings, assembling the ceiling group on the top of the module frame;

electromechanical equipment assembly: assembling electromechanical equipment and pipelines inside the module frame, or selectively conducting assembly of the electromechanical equipment and the pipelines and internal wall assembly alternately;

interior assembly: for modular houses needing interior decoration, assembling sanitary ware and doors in the module frame;

movable window group assembly: for modular houses needing movable windows, installing the movable windows at the inner side of the end of the module frame, which can be turned out or withdrawn along the end frame;

ceiling group assembly: installing the ceiling group above the suspended ceiling group;

component loading: packing material that needs to be installed on site intensively and putting in the module frame;

movable floor assembly: hinging the movable floor and the fixed floor to form a flipping structure, and after the movable floor is withdrawn, forming a side plate of the module frame to form a complete modular house.

Claim 9: The assembly method for the modular houses according to claim 8, wherein when the modular house is a ladder mold, the suspended ceiling group assembly, the assembly of interior sanitary ware, the movable window group assembly and the movable floor assembly are not conducted; after the module frame assembly and welding, the external wall assembly and the fire protection layer assembly are conducted; after the fire protection layer assembly, the assembly of the electromechanical equipment and the pipelines is directly entered; after the assembly of the electromechanical equipment and the pipelines, the assembly of the doors is conducted; after the assembly of the doors, component loading is conducted; after the component loading, the ceiling group assembly is conducted; and then, waterproof measures are taken

for packing and transportation.

- Claim 10: A field installation method for modular houses, comprising the following steps:
removing the corner fittings when the corner fittings on the modular house are detachable structures;
after the modular house is hoisted to a target position, hoisting a next modular house, and spacing the next modular house and the placed modular house which share the movable floor that is turned to a horizontal position; and
connecting and fixing the movable floor and two adjacent modular houses;
when the modular house has the movable window, rotating out the movable window as an end bay window or a balcony window of the third modular house, and fixing the movable window;
when the modular house has the external wall and the air conditioner external unit, pushing out the air conditioner external unit;
stacking and fixing all modular houses, and communicating the electromechanical equipment and the pipelines inside each modular house;
after all the modular houses are built, installing a roof group and an equipment room module to form an overall structure.
- Claim 11: The field installation method for the modular houses according to claim 10, wherein before the modular house is hoisted, the movable floor of the modular house is turned down at first to a horizontal position and then hoisted.
- Claim 12: The field installation method for the modular houses according to claim 10, wherein both ends of the movable floor are prefabricated with the beam bars, and the movable floor is connected with the columns of the end frames of the adjacent modular houses through the beam bars; the reinforcing beam bars are arranged below the beam bars; when adjacent modular houses are stacked up and down, one end of the beam bars is connected with the column of the upper modular house and one end of the reinforcing beam bars is connected with the column of the lower modular house;
when adjacent modular houses are connected front to back, the columns of each modular house are aligned front to back and connected through threaded

connectors into a whole to form a double-column structure;
when the equipment room module is installed on the roof group, at least one side of the equipment room module is provided with a functional bracket that can be folded; when the equipment room module is transported, the functional bracket is in a withdrawn state to conform to the container transportation standards; and during field installation, the functional bracket is in an unfolded state.

Claim 13 The field installation method for the modular houses according to claim 10, wherein a foundation pier is arranged between the modular house at the bottom layer and a foundation embedded part; the foundation pier adopts a composite structure; an upper layer has the same material as a body of the modular house, and a lower layer has the same material as the foundation embedded part.