A relocatable building module apparatus and shipping crate for shipping a disassembled module. A folded module can be placed in position on location and walls erected in their upright position relative to the floor by rotating the walls on hinged points on the floor and locking them in place. A roof can then be attached to the walls and several modules can be aligned together in a positive alignment.
RELOCATABLE BUILDING MODULE AND SHIPPING CRATE

This is a continuation, division, of application Ser. No. 150,420 filed June 7, 1971.

BACKGROUND OF THE INVENTION

The present invention relates to modular prefabricated relocatable building structures. It has frequently been a requirement, especially by governmental units, for buildings which are required to be assembled rapidly where materials or skilled labor are not available such as overseas areas, in severe weather conditions or when urgent or frequent relocation is required. It is accordingly an object of the present invention to provide a modular prefabricated relocatable building structure which can be factory produced for rapid assembly and disassembly and which will also have a rugged long life under a variety of environmental conditions and require a minimum of maintenance along with the ease of erection and disassembly in a rapid manner by semi-skilled labor with simple tools and in severe weather conditions. In recent years, the rapidly increasing cost of materials and labor for building houses has resulted in great interest in the development of large numbers of module type homes which are factory manufactured and placed on a chassis with wheels for movement to a desired location. There has also been great interest in development of modular type homes which are factory built for placement upon the beds of lowboy trucks or similar vehicles for transportation from the factory to the building site and which usually have two sections for attaching together to form a complete house. However, these prior art units are not adapted for shipment by other means such as on ships to foreign countries because of their bulk in their assembled form. There have been many types of prefabricated units in which sections of a building such as the walls, floor and ceiling are packed aboard a vehicle for shipment to the building site where it is assembled by skilled labor. This reduces the overall labor required and it decreases the time span required to assemble a house but still requires a fairly large amount of skilled labor to assemble the prefabricated house. These prior art building units are meant for permanent installation except for some of the mobile home units which can be moved on their wheels to different locations. There have been a number of folding and relocatable type building structures. Typical of these units is U.S. Pat. No. 2,592,610 for a PREFABRICATED FOLDING BUILDING, which is a building construction which can be manufactured at a factory and assembled at a site, and provides a wall unit in which the floor and roof pivot therefrom for assembly; U.S. Pat. No. 3,015,291 for a COLLAPSIBLE PORTABLE BUILDING, teaches such a building which can be partially collapsed to reduce the size of the building while it is being moved; and U.S. Pat. No. 2,751,635, for a PORTABLE PREFABRICATED SHELTER, and has a building section hinged to fold much like a folded paper carton; U.S. Pat. No. 3,103,709, for BUILDING STRUCTURES, provides a building unit which can be collapsed to a low height and formed into a compact bundle for transporting to a site and then assembled to form a building; U.S. Pat. No. 2,701,038, for a PORTABLE HOUSE, teaches a portable building which can be folded into a flat unit for stacking of the units for transporting the unit to a site; and U.S. Pat. No. 3,517,962, illustrates a KNOCK-DOWN MOBILE HOME ASSEMBLY, in which the mobile home has collapsible walls which fold over to its floor structure, and a roof which is mountable to the walls in an erected position.

SUMMARY OF THE INVENTION

The present invention relates to a modular prefabricated relocatable building structure into a shipping crate for shipping such a structure. The relocatable building module has a floor section having metal structural members supporting the floor and wall sections having similar metal structural members which are hinged to the floor section structural members so that the walls can be folded onto the floor and then moved to an upright erected position. A locking assembly provides for a rapid locking of the wall sections to the floor section in its erected position and the roof section is removably attached to the wall sections when the wall members are in their erected positions. A plurality of leveling members are attached to the floor section structural members for leveling the floor section and hence the building module on its site and alignment means attached to the module allow a plurality of the modules to be rapidly interconnected. A folded module can be placed in position and quickly leveled, the wall members erected and locked in their upright position and the roof section placed thereon. Several modules can be aligned together and interconnected to provide one large unit of side by side modules and can also provide for a plurality of levels with the heating and air conditioning ducts and other facilities interconnecting on the individual modules. The shipping crate for shipping the relocatable building module has a base made up of structural member attached together and has a plurality of upright structural members attached to the base. The base has crates for placement of wall partitions and related building hardware, and the like, attached thereto. The upright structural members have brackets attached thereto for placing a roof section, and a set of removable brackets for attaching floor section with walls attached thereto, when such walls are in a folded position. The upright members also have lifting hooks connection thereon for lifting these crates fully loaded. The walls, floor and roofing sections are adapted for being wrapped in plastic, while in the shipping crate. The upright members can be interconnected for greater strength and can have means for bolting the upright members to another similar shipping crate upright members for combining upper and lower levels together in one shipping unit.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of this invention will be apparent from a study of the written description and the drawings, in which:

FIG. 1 is a perspective view of an assembled building made with a plurality of modules in accordance with the present invention;
FIG. 2 is an exploded view of the upper and lower level modules in accordance with the present invention;
FIG. 3 is an exploded view of a loaded shipping crate in accordance with the present invention;
FIG. 4 is a perspective view, with portions cut away, of foundation connection and wall hinge lock for a
lower level module in accordance with the present invention;
FIG. 5 illustrates an interconnection joint for connecting upper and lower module units; and
FIG. 6 illustrates an alignment guide for aligning a pair of modules.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention deals with a modular prefabricated relocatable building structure which can typically be built 10 feet long by 24 feet wide. Assembled modules can have first floor and second floor modules followed by a roof and in which only the latrine module needs to be shipped in an erected position. Each module may have a steel floor deck material over a structural steel frame and the insulated wall panels may be integral with the vertical structural columns and fold down horizontally for packaging. Second floor module can be similar to the first floor module except that the lay-in ceiling for the first floor is attached to the underside of the floor structure and a utility space containing all air conditioning ducts, air handlers, electric power supply and communications space is suspended to run longitudinally down the center of a building through a plurality of modules. The roof structure may contain similar features for the second floor area and all environment insulation may utilize foam, applied polystyrene beneath the first floor, polystyrene sandwiched within the walls and rigid board type insulation on the roof. Latrine modules, which are not illustrated, may be constructed to be shipped fully erected with all features in place, and stair modules may be hinged up into the second floor module for shipment. The utility module may be a self-contained separate structure containing the chilled water pumps, controls, bore and power panels and a fuel oil tank, if utilized, may be placed on a common base with the utility module. Erection of a typical building will consist of simply placing a first floor module in position, leveling it, standing up and locking the hinged walls, installing the second floor on the first floor walls and placing the roof structure. Adjacent modules are self-aligning and the process is repeated.

Referring now to FIG. 1 of the drawing, there can be seen an assembled building 10 having a plurality of first floor modules 11 and second floor modules 12 assembled together. The modules are aligned side by side and have end walls 13 attached thereto along with plurality of doors 14 and upper level canopy attachments 15 and lower level canopy attachments 16. Each module wall is illustrated as having one window 17 therein but it could of course have several windows or no windows as desired. The building has a roof 18 and a floor ceiling combination 20 between the lower unit 11 and the upper unit 12.

Referring now to FIG. 2, there can be seen that the modular unit 11 may be set on a grade beam 21 having grouting spaces 22 for placement of flat portion 23 of leveling jacks 24 which are attached to elongated structural member 25, which leveling jack may be threaded for raising or lowering to align each corner of the module 11 during assembly and allow adjustments for settling of the building. The flat bottom portion 23 of the leveling jack when placed in the grouting space 22 may be grouted therearound for anchoring it to the grade beam 21. The elongated members 25 are interconnected by a plurality of structural box members 26 which are interconnected with members 27, having structural metal deck 28 attached thereto which in turn has the floor panels 30 which may be cemented asbestos board, or the like, attached thereover and which may have carpet 31 placed thereover to provide the floor section of the lower module. The elongated box member 25 has lifting pins 32 therein for lifting the individual unit, such as with a crane, for placement on the graded beams 21 and also has tapered alignment pins 33 fixedly attached thereto for aligning pairs of modules, as will be described in more detail in connection with FIG. 6. The ends walls 34 of the building have base structural box members 35 and upright extending box structural members 36 along with upper structural members 27 welded together into a rigid wall structure which is hinged to the elongated structural members 25 by pins, or the like, 38, as will be described in more detail in connection with FIG. 4. Walls 34 may be folded on hinge pins 38 to lay flat on the floor and then be extended into their upright position for assembly, in which position they can be locked. The wall structural members have exterior walls panels 40 along with window units which can be aluminum frame sliding glass window units, as illustrated, or any other type as desired, but attached to the exterior side 40. Metal flashing 42 has been attached to the top portion of the wall structure and the exterior unit can be separately insulated and can have panels 40 of insulating exterior wall material. The frame members 36 provide attaching holes 43 for engaging similar holes 44 on an overhang canopy 45 which canopy provides exterior shelter from rain, or snow, or the like, for people entering or leaving the building. Inasmuch as the modules illustrated in this figure are for a unit such as in FIG. 1, there would be a plurality of modules interconnected with only end walls at each end of the plurality of modules which are then attached upon completion of the end modules. The upper module 12 has structural box members 46 with interconnected structural members 47 and 48. The structural members 46 similarly have lifting pins 50, tapering alignment pins 51, and hinge pins 52 therein. The end wall structure 53 is similar to that taught for the lower unit and hinges on the pins 52 to allow a folded unit foldable onto the floor unit. This unit similarly has a structural metal deck 54 similar to the metal deck 28 and floor boarding 55 thereon but has been covered with tile 56, such as vinyl asbestos tile rather than the carpet 31. Brackets 58 allow for the alignment and attachment of the upper and lower units and the ends walls of the upper unit have exterior wall panels 59 along with window units 60 and upper metal flashing 61. Brackets 57 are used to connect modules together. The floor of the second level unit has a utility duct 62 attached thereto having the heating and air conditioning conduits 63 with grills 64 thereon along with separate power line tubing 65. A roof section 65 has elongated structural box member 66 having tapering pins 67, lifting pins 68 and brackets 70 for attaching to structural members 53 of the upper level module 12. The roof has interconnecting box structural member 71 with utility conduits passing therein along with roofing panel 72 which can be nylon liquid roofing with a fiberglass mesh at the panel joints and may contain rigid insulation board 73 on the structural metal deck 74. The upper module similarly has an overhang 75 which may have a welded steel beam 76 welded to removable steel
plate 77 along with bracket 78 for attaching to the building structure and is typically the same as the overhang 45 of the lower module.

As can be seen at this point, the lower module can be lifted in place with a crane, or the like, connecting to lifting pins 32 to place the leveling jacks 24 into grooving spaces 22 of the grade beam 21. The lower unit can then be leveled utilizing standard carpenter's levels for leveling the four corners of the module. Once leveled, the folded walls 34 can be erected on pins 38 and locked in place. Then the upper module 12 floor can be lifted in place by utilizing pins 50 and looked to the lower walls by means of brackets 58 so that the floor of the upper unit will have a ceiling 80 thereunder for providing a ceiling for the lower module and a floor for the upper module. The upper module then has its walls swing on pins 52 and the side walls are locked in place. The roof section 65 can then be engaged at pin 65 for lifting by a crane and putting it in place on top of the upper module walls which are aligned by the extending portion 81 of the end of the structural member 66 and with the end portion 82 interconnecting and locking along with bracket 70 to structural members 53. Similarly, the upper and lower modules are aligned with brackets 58 to each other. The upper roofing section is then locked in place. This is followed by a second pair of modules being assembled in the same manner except for being adapted to slide on the tapered alignment pins 32 for alignment with the first set of modules. The overhangs 45 and 75 can be attached at any time during assembly. Inasmuch as most of the on side assembly is performed by bolting members together, it should be clear that the units can be easily disassembled with relatively unskilled labor and crated for relocation with a minimum amount of labor. This is more clearly illustrated in connection with FIG. 3.

Turning now to FIG. 3, a shipping crate for shipping the present relocatable building module is illustrated at 90 having a rectangular base with a pair of short base perimeter frame members 91 and a pair of elongated base perimeter members 92 with a plurality of connecting frame members 93 and a center reinforcing frame member 94. Members 91, 92 and 94 can all be box or channel members of structural steel welded together. The frame has four upright channels 95 which can be welded or bolted to the elongated base members 92 and each upright member 95 has lower brackets 96 and upper brackets 97 along with a lifting hook 98 thereon. Lifting hook attachment 98 is also utilized for the upper connections of reinforcing wire cable 100 which is connected between upright members 95 and between upper lifting hooks 98 and lower wire holding brackets 101. It should of course be clear that reinforcing members other than metal cable can be utilized, such as rigid steel stock. Brackets 96 and 97 have bolt holes therein and there are also bolt holes 102 in the upright member 95 caps 103. Caps 103, with bolt holes 102 allow for a first floor shipping crate to be rested on and bolted to the uprights 95 of the second floor shipping crate illustrated. The lifting hooks allow a crane, or the like, to lift a single crated module sitting on and anchored to the base with a pair of wooden crates 104 and 105 which can typically be 1-foot deep wooden crates to ship interior wall partition parts, foam filler gaskets, battens, canopy overhangs, miscellaneous bolts and nuts, and light fixtures, and the like. These crates may be lined with and items wrapped with polyethylene and sealed water-tight. An upper level roof unit 106 having structural members 107 and a utility and air conditioning conduit 108 thereon, and a pair of protruding bolts 109 attached thereto would typically be wrapped in polyethylene and sealed water-tight for shipment and the unit placed on brackets 96 on the uprights 95 with the bolts 109 going in the bolt holes 108 in the brackets 96 and being bolted thereto, and with the utility passageway 108 fitting between the crates 104 and 105 in a space of predetermined size. The floor and wall unit 111 has a floor 112, a utility conduit 113, walls that fold up as previously described, which hinged walls have window units 115 therein. The folded walls which are hinged at one end to the structural members 116 have been anchored to the floor by metal strap 117 which is wrapped around corner pieces 118 to protect surfaces of the walls and floor unit. This second floor unit would typically have plywood and polyurethane pads to protect the glass window 119 and would be wrapped with polyethylene and sealed water-tight for shipment and then would be placed on the brackets 97 with bolts 120 of structural members 116 fitting into anchor bolt holes 121 on brackets 97 for being bolted thereto and held in place. Sufficient room is provided between brackets 97 and 96 for the conduit 113. This crate provides for lifting these units on cranes, or the like, especially for shipment in cargo-type ships and provides for the easy stacking of the crates on the uprights 95 and for bolting pairs of upper and lower unit crates together. It should be noted that the crates are packed so that the flooring unit comes off first for placement, followed by the roof unit and then the crates 104 and 105 can be opened for removal of the remainder of materials and hardware. The crates can then be safely stored for shipping the relocatable unit should this later become necessary. It should also be noted that the brackets 97 are removable connected to the uprights 95 so they can be removed out of the way for inserting and removing the roof unit 106 and these units can be bolted with bolts 122, if desired, or removable connected with any other type fasteners desired.

Referring now to FIG. 4, a first floor beam column foundation connection is illustrated having elongated box beams 125, short spanning box beams 126 along with the column or upright beams 127. The long span beams 125 have a threaded anchor or leveling bolt 128 attached thereto by nut 130 threaded on a threaded end 131 of the bolt 128. The other end has a flat surface 132 which has been set into a grooving space 133 of a grade beam 134 and grouted with grout 135 for anchoring to the beam 134. Slotted plates 136 have been welded to the columns 127 and hinged by threaded bolt 137 to the long span beam 125. These plates have slots 138 at predetermined angles therein along with an angled surface 140. Threaded bolts 141 are welded to the long span beam and have washers 142 and nuts 143 thereon so that the wall unit having structural members 126 and 127 can be folded on the hinge bolt 137 resulting in the nuts 141 engaging in the slots 138 of the plates 136. The nuts 143 and washers 142 would typically already be loosely fitted onto the bolts 141 and can be tightened in position in an upright and level position and the hinge bolts 137 can be tightened to provide additional frictional engagement of the wall structural members with the floor structural member 125. As can be seen, this provides a simple structural folding
corner which can be assembled or disassembled rapidly by relatively unskilled labor and also provides an easy and rapid means for leveling the relocatable unit without having to use external jacks on hand for placing the unit in proper position. It also provides for adjustments in the event of settling of the building. It should be noted that beam 125 has a rectangular removed portion 145 for allowing entrance into the box channel 125 in order to tighten all of the nuts onto the bolts and for leveling the anchor leveling bolt 128. FIG. 5 illustrates a means for connecting upper end lower modules together and has upper level long span beams 145 and short span beams 147 along with a column 148 welded to the short span beam 147. Column 148 has slotted plates 150 welded thereto and hinged on pins or bolts 151 and anchored as previously described in connection with FIG. 4. The bottom portion of the beams 146 and 147, however, do not have the leveling bolts of the lower module unit, but rather have a pair of brackets 152 and 155 welded to beams 146 and 147 respectively, having slots 154 and 155 therein. The lower level column 156 is illustrated having its short span beam 157 connected thereto and the column 156 has a bolt 159 welded thereto on one side and a bolt 160 welded thereto on another side, adapted for fitting in the slots 154 and 155 respectively of brackets 152 and 153. Threaded bolts 158 and 160 have a pair of lock washers 161 and nuts 162 for anchoring the brackets 152 and 153 to the column 156. This simple locking means provides for easy assembly and disassembly while aligning the upper module to the lower module.

FIG. 6 shows a typical alignment between a pair of sides by said modules, and has a corner of one module having a long span beam 170, a column beam 171, a short span beam 172 along with slotted plates 173 hinged at 174 and locked with bolts at 175. The long span beam 170 has a circular opening 176 for receiving a tapered pin spacer 177 which has welded at 178 to the long span beam 180 of a second module in predetermined locations. The second module also has a short beam 181, an upright column 182, along with slotted plates 183. The tapered pin spacer 177 may have a 2-inch tapered surface and a base portion 185 with an annular ledge 186 for aligning a pair of modules in a predetermined space apart. The modules can then be bolted together with brackets 157 of FIG. 2 or connected by any means desired, preferably by means which can be easily disconnected for disassembling the modules for relocation.

It should be clear at this time that a prefabricated modular relocatable building structure has been provided but it should also be clear that variations and equivalents are anticipated without departing from the spirit and scope of the invention and that while no particular materials are anticipated, the structural system could consist of cold rolled structural steel box members in which the module frames are welded with column and wall members folded down for packaging. The frames are thus rigid or semi-rigid in both directions for strength and to carry wind loads in any direction. Each module is structurally independent during erection and permanently independent when adjacent upper modules are in place. The rigidity of the hinged joints is assured by the use of high strength bolts with self locking nuts tightened by the turn of the nut method to produce a friction connection. The bolts and the hinged joints are shipped hand tightened and tightened for joint rigidity after adjustment of the walls. The erection alignment is achieved by mating the two-inch diameter male and female tapered pins which are designed to give positive alignment and module spacing in the most difficult of working conditions. The foundation and anchoring system is designed for grade beam application which allows a building to be erected virtually on any hard span surface. Anchoring and permanent bearing is assured by field grouting the foot of the leveling jack after erection is completed, but it of course should be clear that the present application is not anticipated as being limited to grade beam applications even though this allows non-reinforcing concrete grade beam foundation continuously around the periphery of the building. It is also anticipated that quick fitting and attaching end wall panels can be applied along with doors and any type of plumbing connections desired even though modular piping innerconnections generally include flexible unions allowing sufficient variation for rapid connection and adjustment. The same applies to the electrical wiring and lighting for the modules. It should also be understood that it is anticipated that the units can be assembled with only semi-skilled labor, but does not require a crane, such as a 20-ton capacity crane along with crane rigging spreaders, ladders and low scaffolding equipment in which a skilled operator would be required for the crane for setting the units in place.

Accordingly, this invention is not to be construed as limited to the particular forms disclosed herein since these are to be regarded as illustrative rather than restrictive.

1. A shipping crate for shipping a relocatable building module comprising in combination:
   a. a base having structural members attached thereto to form said base;
   b. upright members attached to said base structural members and being substantially perpendicular to said base;
   c. crate means attached to said base and being adapted for placing components of said module therein;
   d. bracket means attached to said upright members adapted for attaching a roof section of said module thereto;
   e. removable bracket means attached to said upright members adapted for attaching floor and wall units of said module thereto; and
   f. said upright members having means thereon for attaching means for lifting said crate whereby a building module can be crated in a compact manner.

2. The crate in accordance with claim 1 in which said upright members have reinforcing members connecting pairs of said upright members for added strength therebetween.

3. The apparatus according to claim 2 in which said reinforcing members are crossed cables.

4. The apparatus according to claim 3 in which said upright means has means for attaching a second shipping crate thereto for shipment of pairs of said relocatable building modules.

5. The apparatus according to claim 4 in which said base has perimeter structural members having said upright members attached thereto and has intermediate structural members located between said perimeter structural members and connected to said perimeter structural members.

* * * * *