A capsule-unit house comprising structure assemblies arranged in series with a gap therebetween and each having a plurality of horizontal structure elements disposed one above another, and foldable supporting means for supporting said adjacent horizontal structure elements at ends thereof; said supporting means including wall members; and a filler filled in said gap so as to form vertical structure elements together with said supporting means, and a method of building such a capsule-unit house.

3 Claims, 17 Drawing Figures
CAPSULE-UNIT HOUSE

This invention relates to a capsule-unit house and method of building same, and more particularly, to a capsule-unit house constructed by prefabricating foldable, compact structure assemblies convenient for transportation and storage, carrying these assemblies to the construction location in order to set up the desired house in said location.

In recent years, a set-up building, commonly called a prefabricated house, particularly a capsule-unit house has been widely used. In this type of house, its components, such as columns and panels, were performed in the factory and conveyed to the construction location so as to set up the desired house there.

There were, however, the serious drawbacks that a large assembling machine was required for assembling large components, that much labor and time were needed for such assembly, and that a wide open space in the construction location was necessary to accommodate the components in large variety and in immense quantity.

There has been proposed an improved cell-unit house in which the structural units were prefabricated in the factory and carried to the construction location in order to set up the house there. Indeed, considerable labor and time could be saved in assembling the components. There were, however, the serious disadvantages that a large assembling machine was required for setting up a multistory house and that the transportation of large structural units was difficult and expensive. In addition, a wide site was necessary for higher building efficiency because the massive units were wholly or partially placed in the construction location.

Accordingly, the object of the present invention is to provide a method of building a capsule-unit house by joining together adjacent structure assemblies prefabricated in the factory and folded for easy transportation and storage by filling a filler in gaps between said assemblies and a capsule-unit house built by said method.

In each structure assembly of the invention, two or more horizontal structure elements are disposed one above another. The ends of the horizontal structure elements are connected with the corresponding ends of those disposed right above by a plurality of structural shape assemblies. Each structural shape assembly comprises an upper and a lower structural shape. The upper end of the upper structural shape is pivoted to one end portion of the upper horizontal structure element; the lower end of the lower structural shape to one end portion of the lower horizontal structure element; and the upper end of the lower structural shape to the lower end of the upper structural shape, thereby to enable the structural shape assemblies to be folded. A locking means is preferably mounted on a pivot of each assembly to fix the pivot when the assembly is vertically spread or straightened out.

The upper structural shapes of each assembly are embedded in a single wall member to connect the ends of vertically adjacent two horizontal structure elements on the same side. The lower structure shapes may also be embedded in another wall member. In this case, the structural shape assemblies and wall members constitute supporting means. Alternatively, a wall member may be pivoted to either end of the upper or lower horizontal structure element so as to erect the wall members when the structure assembly is unfolded. In this case the structural shape assembly and/or the wall members constitute supporting means.

The structure assemblies are mostly prefabricated in the factory by the processes described above and transported to the construction location with the supporting means folded. The horizontal structure elements are then lifted by using a lift or the like to unfold the supporting means and fixed by the locking means to prevent it from folding again and to carry the horizontal structure elements and their associated supporting means. The unfolded structure assemblies are arranged in series with a gap provided between the facing supporting means of the adjacent structure assemblies. A semifluid solidifiable filler fixed on the supporting means after solidification is filled in said gap. The filler used is a filling material such as cement that can withstand a strong stress after solidifying. A vertical structure element is composed of the filler and supporting means as a single unit.

The present invention can be more fully understood from the following detailed description when taken in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view showing a capsule-unit house according to the invention;
FIG. 2 is a schematic side view illustrating vertical structure elements;
FIG. 3 is a side elevation indicating a folded structure assembly;
FIG. 4 is a perspective view showing part of supporting means;
FIG. 5 is a perspective view, partially broken away, of the supporting means of FIG. 4;
FIG. 6 is a perspective view illustrating a pivot section of the upper horizontal structure element and supporting means when the supporting means is folded;
FIG. 7 is a perspective view indicating an engagement of the upper horizontal structure element and supporting means when said supporting means is unfolded;
FIG. 8 is a side view of FIG. 7;
FIG. 9 is a sectional view taken along the line 9—9 of FIG. 8;
FIG. 10 is a perspective view representing a pivot section of the supporting means in the center;
FIG. 11 is a side elevation of FIG. 10;
FIG. 12 is an oblique view showing a pivot section of the supporting means and lower horizontal structure element;
FIG. 13 is a perspective view sketching a horizontal section of the vertical structure element in an embodiment of the invention;
FIG. 14 is a plan view of FIG. 13;
FIG. 15 is a side elevation schematically showing the structure assembly with its horizontal structure element lifted by a jack;
FIG. 16 is a side view schematically representing vertical structure elements in another embodiment of the invention; and
FIG. 17 is a side elevation illustrating a structure assembly of FIG. 16 when folded.

Referring to FIG. 1, a structure assembly generally designated by 21 comprises a plurality of horizontal structure elements disposed one above another and a pair of supporting means.
The horizontal structure elements 22, 23 and 24 shown in this embodiment consist of three sections: a lower or bottom horizontal structure element 22, a midstory horizontal structure element 23, and an upper or top horizontal structure element 24 having the following functions: the element 22 serves as the floor; the element 23 as the ceiling (lower surface) and floor (upper surface); and the element 24 as ceiling or roof.

It should be understood that a single-story house has a structure assembly with two horizontal structure elements and that a multistory house has a structure assembly with the number of horizontal structure elements corresponding to the number of the stories.

The horizontal structure elements 22, 23 and 24 indicated in the embodiment are substantially rectangular members having strength withstanding heavy loads. The elements 22, 23 and 24 have legs 22c, 23c and 24c respectively in the lower end portion on either end. Preferably these elements may be slabs prefabricated in the factory.

Supporting means 25 connects the equiside ends 22a and 23a, 23a and 24a of the horizontal structure elements 22, 23, 23 and 24, respectively. Supporting means 26 couples the other equiside ends 22b and 23b, 23b and 24b of the horizontal structure elements 22, 23, 23 and 24, respectively. The supporting means 25 and 26 are of the same construction.

In view of the same structure of the supporting means 25 and 26, the former is only described in detail for simplicity. The supporting means 25 comprises an upper wall member 27 and a lower wall member 28 both of which are small in thickness and rectangular in shape (FIGS. 1 to 3). The wall members 27, 28 preferably are made of cement. The supporting means 25 also comprises a plurality of structural shape assemblies 29 arranged in parallel to one another. Each member 29 consists of an upper structural shape 30 and a lower structural shape 31. Each structural shape 30 or 31 is Z-shaped in section with flanges 33 and 34 on both lateral sides. A plurality of openings 35 are perforated in a web 32. The structural shapes 30 and 31 preferably are made of steel. The flange 34 of the structural shape 30 (or 31) is embedded in the wall member 27 (or 28) at right angles thereto so as to cause the opening 35 and flange 33 to be exposed to the atmosphere. The flanges 33 are substantially equidistantly separated from the wall members 27 and 28. The upper end portion 30a of the upper structural shape 30 protrudes higher than the upper end of the upper wall member 27 (FIGS. 6 to 8). A quadrant connecting portion 30b extending downward from the lower end of the upper wall member 27 is formed on the lower end portion of the upper structural shape 30 (FIGS. 10 and 11). A connecting member 36 is implanted in the leg 23c of the upper horizontal structure element 23 in the position corresponding to the upper end portion 30a of the upper structural shape 30 (FIGS. 6 to 8). The lower end portion thereof 36a projects downward from the lower end of the leg 23c. The lower end portion 36a of the connecting member 36 and the upper end portion 30a of the corresponding upper structural shape 30 is pivoted to each other through a pivotal shaft 37 consisting of pin, bolt-nut assembly, or the like in the position right below the leg 23c. When the structural shape 30 and the member 36 are aligned as shown in FIG. 8 after the upper structural shape 30 rotates counterclockwise in FIG. 6 around the pivotal shaft 37 with respect to the connecting member 36, the structural shape 30 and the member 36 overlap each other by l5.

The front side surface (right-hand side surface in FIG. 6) of the member 36 abuts on the inner surface of the flange 33 of the structural shape 30 so as not to permit the structural shape 30 to rotate counterclockwise any longer. Through holes 38 and 39 to be in place when unfolded are perforated in the lower end portion 36a of the member 36 and in the upper end portion 36a of the structural shape 30 respectively so as to align each other when the structural shape 30 is unfolded (FIG. 9). Locking means 40 consisting of pin, bolt-nut assembly, or the like is inserted into the through holes 38 and 39 to prevent the pivotal movement of the structural shape 30 with respect to the member 36.

The lower end portion 31a of the lower structural shape 31 protrudes lower than the lower end of the lower wall member 28 (FIG. 12), while the upper end portion thereof is provided with a quadrant connecting portion 31b extending upward from the upper end of the lower wall member 28 (FIG. 11).

A connecting member 41 is implanted in the leg 22c of the lower horizontal structural element 22 in the position corresponding to the lower end portion 31a of the lower structural shape 31 (FIG. 12). The upper end portion 41a of the connecting member 41 projects upward from the upper surface of the horizontal structure element 22. The upper end portion 41a of connecting member 41 and the lower end portion 31a of the corresponding lower structural shape 31 are pivoted to each other in the position right above the leg 22c through a pivotal shaft 42 consisting of pin, bolt-nut assembly, or the like. When the lower structural shape 31 and the connecting member 41 are aligned as shown in FIG. 12, they overlap each other by l6, and the front side surface of the member 41 abuts on the inside surface of the flange 33 of the structural shape 31 so as not to permit the structural shape 31 to rotate clockwise beyond the abutment with respect to the member 41 (FIG. 12).

There are provided through holes 43 which are perforated in the upper end portion 31a of the structural shape 31 and in the upper end portion 41a of the member 41 respectively and which align each other when unfolded. When locking means 44 consisting of pin, bolt-nut assembly or the like is inserted into the through holes 43 after unfolding the structural shape 31, the pivotal movement between the member 41 and the structural shape 31 can be prevented. The connecting portion 30b at the lower end of the upper structural shape 30 and the connecting portion 31b of the upper end portion of the lower structural shape 31 are pivoted to each other through a pivotal shaft 45 mounted in the expanded portions 30c and 31c on the front end surface of said connecting portions 30b and 31b (FIGS. 10 and 11). In unfolding the structural shapes 30 and 31 as shown in FIGS. 10 and 11, the connecting portions 30b and 31b overlap by l7. Under this condition, the connecting portion 30b abuts on the inner surface of the flange 33 of the lower structural shape 31 so as not to permit the upper structural shape 30 to rotate counterclockwise beyond the abutment with respect to the lower structural shape 31 and so as not to allow the further clockwise rotation of the lower structural shape 31 with respect to the upper structural shape 30 (FIG.
After the structural members 30 and 31 are aligned with each other, locking means 47 consisting of pin, bolt-nut assembly, or the like is inserted into the holes 46 perforated in the connecting portions 30b and 31b of the members 30 and 31 so as to be aligned with each other when the structural members 30 and 31 are straightened out thereby to prevent the relative motion between the members 30 and 31.

In the wall members 27 and 28, steel bars 48 are arranged horizontally and in parallel to one another (FIG. 5). The bars 48 act to reinforce the wall members 27 and 28 against the longitudinal tensile stress.

The structure assemblies 21 so constructed can previously be mass-produced in the factory. The assemblies 21 can thus be reduced in volume by turning the structural shapes 30 and 31 about the pivotal shafts 37, 42 and 45 and folding the supporting means 25 and 26 at the center C thereof as shown in FIG. 3. Thus, the structure assemblies 21 are conveniently stored and transported.

The horizontal structure elements 23 and 24 are pushed up by lifting means 49, such as hydraulic jacks (FIG. 15) to straighten out the supporting means 25 and 26 as shown in FIG. 4. After the upper and lower structural shapes 30 and 31 are respectively aligned to the connecting members 36 and 41 the locking means 40 is inserted into the holes 38 and 39; the locking means 47 into the holes 46, and the locking means 44 into the holes 43. The structural shape assemblies 29 or supporting means 25 and 26 can thus be securely fixed to the horizontal structure elements 22, 23 and 24 without being folded in the center.

Referring to FIGS. 13 and 14, the structure assemblies 21 thus erected are arranged in series in such a manner that the supporting means 25 of any one of the structure assemblies 21 and the supporting means 26 of the structure assembly 21 adjacent thereto face each other. The supporting means 25 and 26 are so separated from each other by L as to provide a gap A therebetween.

The flange 34 of the structural shape assembly 29 (or upper and lower structural shapes 30 or 31) of each of the structure assemblies 21 is interposed between the outer surface of the upper and lower wall member 27 and 28 of the adjacent structure assembly 21 and the flange 34 of the structural shape assembly 29 thereof (or upper and lower structural shapes 30 and 31). The gap A except for the upper opening is blocked by sheathing boards 50. From the upper opening, the gap A is filled with a semifluid filler 51, which, upon subsequent solidification, is fixed to the supporting means 25 and 26 after solidification. Preferably, the filler 41 is cement. After solidification, the filler 51 and supporting means 25 and 26 i.e., upper and lower wall members 27 and 28 and structural shape assemblies 29 form strong vertical structure elements 52 (FIGS. 1 and 2).

Since the filler 51 also fills in the openings 35 perforated in the structural shapes 30 and 31, the filler 51 is firmly fixed to the structural shapes 30 and 31. The arrangement of flanges 34 of the structural shapes 30 and 31 as shown in FIGS. 13 and 14 ensures that the filler is not broken easily even when a fairly strong force is exerted in the direction to separate any two adjacent structure assemblies. Fillers other than concrete may also be used, provided they are fixedly attached to the supporting means 25 and 26 after being solidified and have a sufficient tensile strength.

When openings 26a for passage etc. are necessary in the vertical structure elements 52, the gap A must be blocked with a sheathing board or the like on the side adjacent to the opening 26a to prevent the filler 51 from flowing into the opening 26a. A sheathing board 50a may also be separately disposed, facing the farthest end portion of the building, as shown in FIG. 2, so as to fill in a gap B between the supporting means 26 and the sheathing board 50a.

FIGS. 15 and 16 show another embodiment of the present invention. Throughout FIGS. 1 to 16, like numerals designate like parts. In this embodiment, the structure assemblies 29 employ single wall members 53 and 54 instead of those upper and lower wall members 27 and 28 of the previous embodiment in which the flanges 34 of the structural assemblies 29 are implanted. The upper end portion 53a of the wall member 53 is pivoted to the lower end surface of one leg 23c of the upper horizontal structure element 23 by connecting means 55 such as a pin. The lower end portion 54a of the wall member 54 is pivoted to the upper end surface of the leg 23c of the lower horizontal structure element 22 diagonally opposed to the lower end surface of the leg 23c. When the supporting means 25 and 26 for the structure assemblies 21 are folded, the wall members 53 and 54 will be placed substantially horizontally as shown in FIG. 17. The wall members 53 and 54 can be erected as shown in FIG. 16 by lifting the upper horizontal structure element 23 with a jack (not shown) as in FIG. 15. By the known connecting means (not shown), the lower end 53b of the wall member 53 may be fixed to the end of the lower horizontal structure element 22 or the lower structural shapes 31 and the upper end 54b of the wall member 54 may also be fixed to the leg 23c of the upper horizontal structure element 23 or the upper structural shapes 30. The upper end 54b of the wall member 54 may also be pivoted to the lower surface of the leg 23c of the upper horizontal structure element 23 instead of the lower end 54a of the wall member 54.

In the aforesaid two emblems, strong vertical structure elements 52 are formed by filling the gap A between the support means 25 and 26 of any two adjacent structure assemblies 21 with the filler 15. Therefore, the supporting means 25 and 26 have only to have sufficient strength to withstand deflection or breakdown due to the weight of the assemblies 21 when the supporting means 25 and 26 are locked by locking means 40, 44 and 47. Accordingly, the supporting means 25 and 26 can be light in weight and simple in construction, as described above, thus providing a lightweight structure assemblies 21. Since the vertical structure elements 23 can serve concurrently as floor and ceiling, the capsule-unit house of the invention, unlike the prior art prefabricated house, need not fill in the open spaces with a filler, thus contributing much to the simplification of the assembly.

What is claimed is:

1. A capsule-unit housing comprising; a plurality of serially arranged structure assemblies each comprising; a plurality of horizontal structure elements disposed one above another, and a pair of supporting means foldable at a center thereof; first and second connecting members on the ends of the horizontal structure elements; said supporting means including a plurality of parallel arranged structural shape assemblies each comprising a lower structural shape having the lower
end pivoted to one of said first connecting members on any one of the horizontal structure elements and a first connecting portion provided on the upper end, and an upper structural shape having the upper end pivoted to said second connecting member on the horizontal structure just above any one of the horizontal structure elements and a second connecting portion provided on the lower end and pivoted to said first connecting portion of the lower structural shape; each of said upper and lower structural shapes being provided on both lateral sides with first and second flanges; locking means which comprises first holes bored through the first connecting members and the lower ends of the lower structural shapes pivoted thereto, first pins inserted into said first holes, second holes bored through the first connecting portions of the lower structural shapes and the second connecting portions of the upper structural shapes pivoted thereto, second pins inserted into said second holes, third holes bored through the second connecting members and the upper ends of the upper structural shapes pivoted thereto, and third pins inserted into said third holes; and a filler filled between said supporting means of the adjacent structure assemblies and fixed thereto.

2. A capsule-unit house as claimed in claim 1 wherein each of said supporting means further includes upper and lower wall members having said first flanges of the upper and lower structural shapes embedded therein respectively so as to cause the second flanges thereof to project equidistantly from said upper and lower wall members.

3. A capsule-unit house as claimed in claim 1 wherein each of said structural assemblies has wall members pivoted to said ends of the horizontal structure elements.

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