July 25, 1967 E. A. FOSTER 3,332,178

DEMOUNTABLE BUILDING

Filed Sept. 15, 1964 3 Sheets-Sheet 1

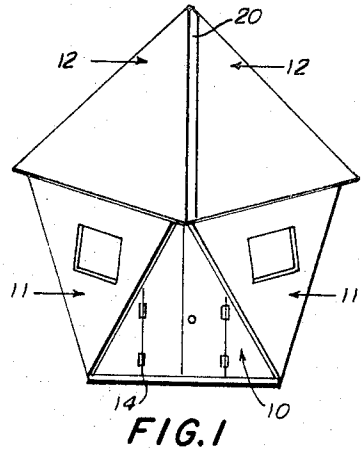

FIG. 1

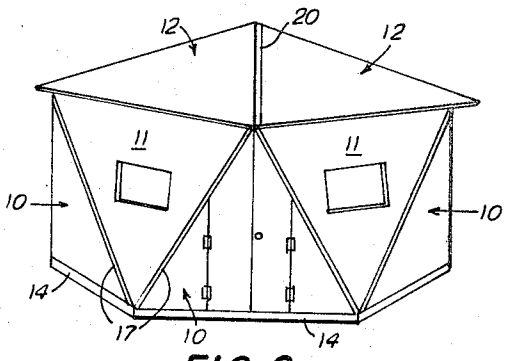

FIG. 2

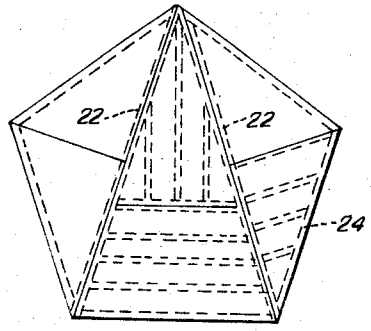

FIG. 3

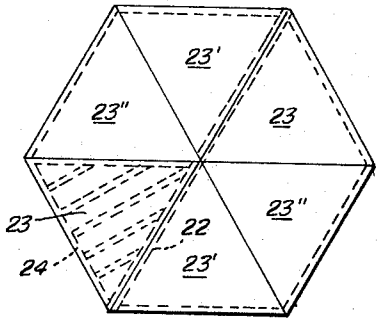

FIG. 4

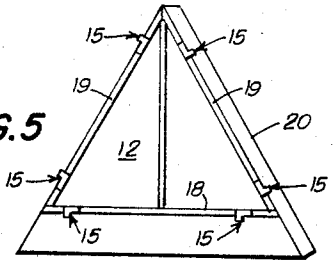

FIG. 5

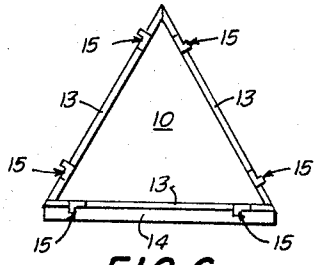

FIG. 6

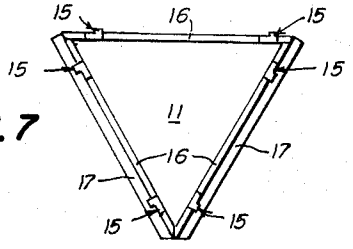

FIG. 7

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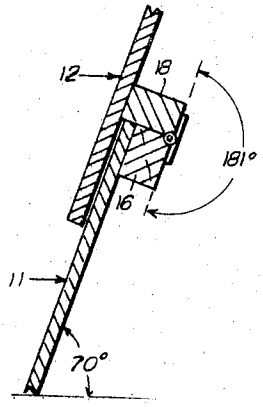

FIG. 8

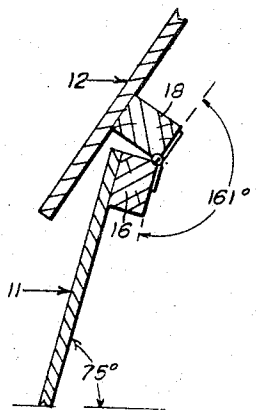

FIG. 9

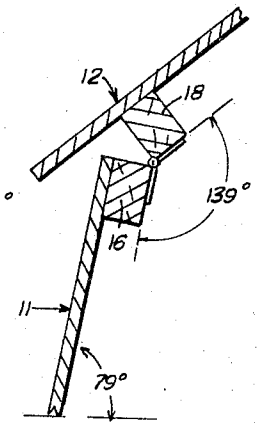

FIG. 10

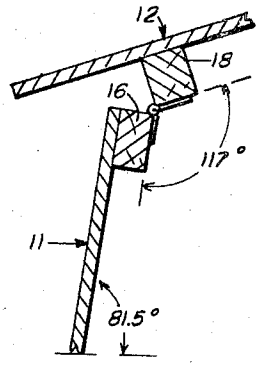

FIG. 11

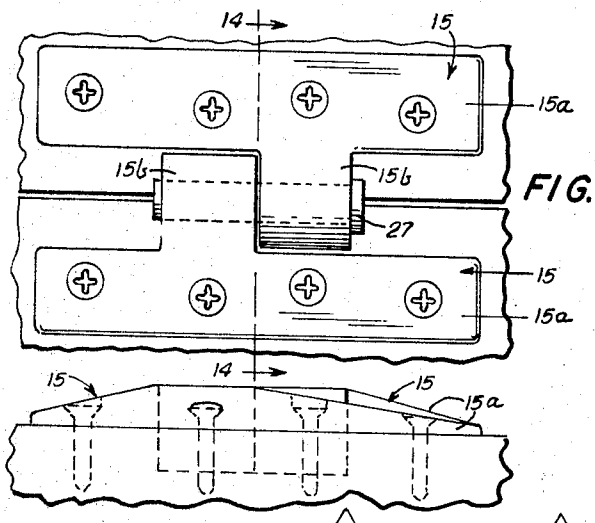

FIG. 12

FIG. 13

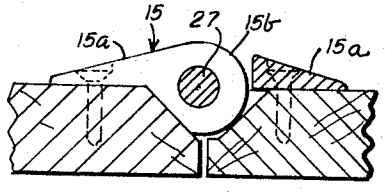

FIG. 14

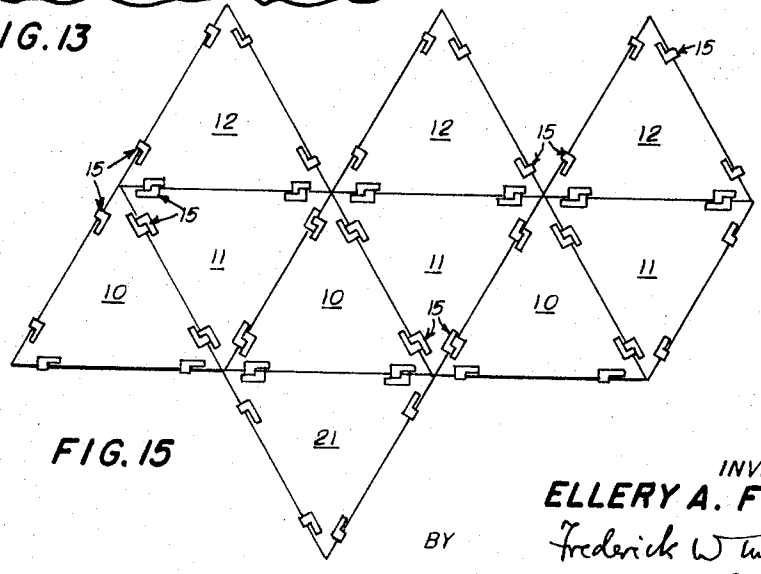

FIG. 15

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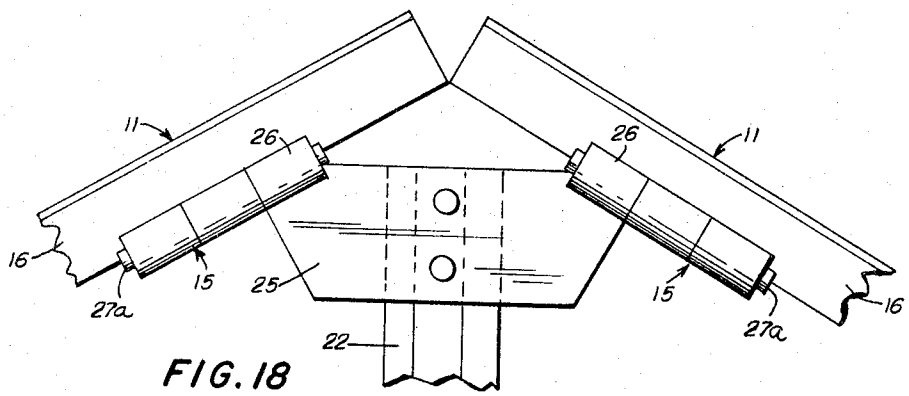

FIG. 18

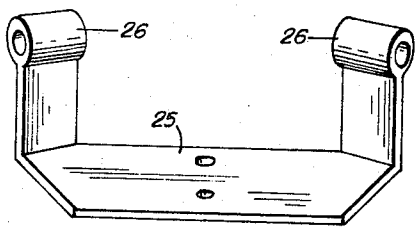

FIG. 19

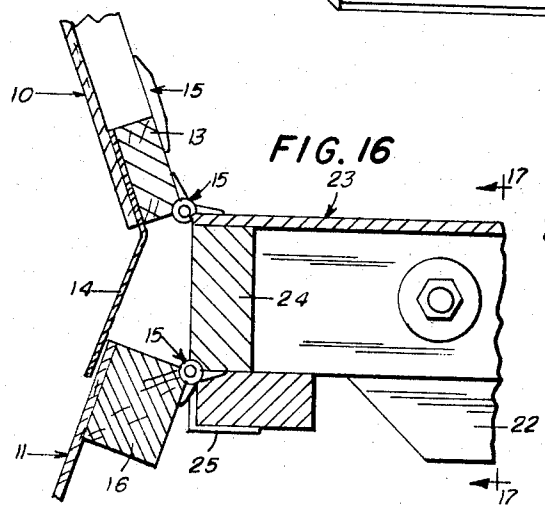

FIG. 16

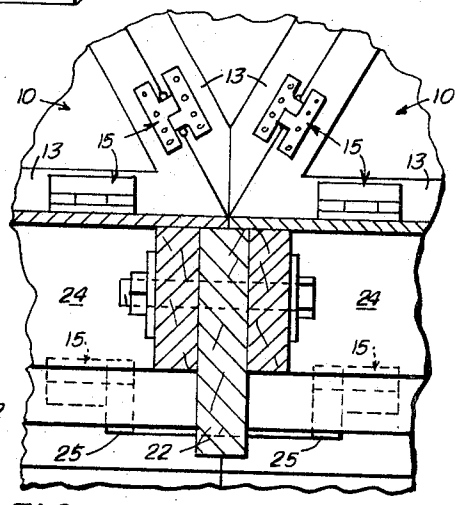

FIG. 17

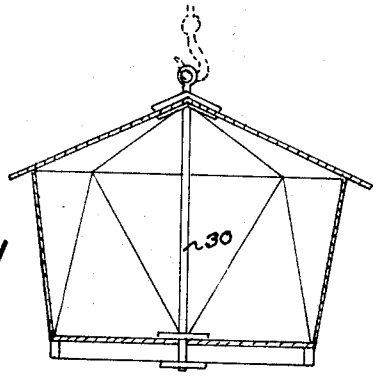

FIG. 21

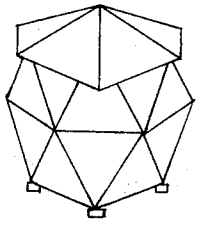

FIG. 20

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United States Patent Office

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Patented July 25, 1967

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DEMOUNTABLE BUILDING

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Bethesda, Md. 20034

Filed Sept. 15, 1964, Ser. No. 396,592
4 Claims. (Cl. 52—70)

ABSTRACT OF THE DISCLOSURE

A set of panels of isosceles triangular shape, each panel being of substantially the same size and shape, each panel having securing means on each side so that the panels are standard and interchangeable with panels of other sets of panels. A plurality of sets of panels being assemblable to form side walls and roofs of polygonal buildings.

This invention relates to buildings and more specifically to demountable or portable buildings of a type which is formed of a plurality of similar panels assembled readily without the aid of special tools and which may be formed into buildings of various configurations.

Such a building may be used by a construction company since it may be readily carried to a construction site by truck and quickly assembled at the site at which the company is busy, and, moreover, it may be removed about the site readily, after it has been assembled, by means of a crane.

Such a building may also be very desirably used in inaccessible places of the world by explorers or the like, since the units may be transported to their place of erection by, for instance, a helicopter, and after arrival may readily and quickly be assembled into a strong, tight building.

It is an object, therefore, of the present invention to provide a plurality of panels which may be assembled quickly and easily to form a building.

It is a further object of this invention to provide building panels of such light but strong construction that while they may be readily transported because of their lightness, the resultant building will be sufficiently strong to withstand the rigors of adverse weather conditions and may in fact be used as a permanent structure.

Other and further objects and advantages of the present invention will become apparent from the following specification taken with the accompanying drawing in which like reference characters refer to similar elements in the several views and in which:

FIGURE 1 is a perspective view of a four-sided building according to the present invention.

FIGURE 2 is a perspective view of a six-sided building according to the present invention.

FIGURE 3 is a plan view showing the framing of the floor for a five-sided building.

FIGURE 4 is a view similar to FIGURE 3 showing the floor for a six-sided building.

FIGURE 5 shows a roof panel from the underside.

FIGURES 6 and 7 each show one of the two forms of side panel used, showing the inside surface of the panels.

FIGURES 8, 9, 10 and 11 are fragmentary sections showing the connection between a side panel similar to that of FIGURE 7 to a roof panel similar to that of FIGURE 5 in a triangular, square, pentagonal, and hexagonal building, respectively.

FIGURES 12, 13 and 14 show plan, elevation and section of a connecting element such as used throughout the construction of the building;

FIGURE 15 shows diagrammatically the assembly for a three-corner building as it would appear if laid out flat.

FIGURE 16 is a fragmentary section taken at the upper corner of a building such as FIGURE 2 but showing the addition of a second floor in lieu of the roof.

FIGURE 17 is a section taken on line 17—17 of FIGURE 16.

FIGURE 18 is a section taken on line 18—18 of FIGURE 17 and of FIGURE 16.

FIGURE 19 is a perspective view of an element seen in FIGURES 16, 17 and 18.

FIGURE 20 is a perspective view of a two-story hexagonal building according to the present invention.

FIGURE 21 is a diagrammatic section taken through a building according to the present invention adapted particularly to be lifted and moved from place to place by a crane or the like.

From FIGURES 1 and 2 it is seen that a building according to the present invention is made up of a series of panels **10**, **11** and **12**. Central panel **10** in each of these two figures is shown as including a door which, however, is not necessary in all such panels **10** as seen in the side panels **10** in FIGURE 2. Similarly, panels **11** are shown with a window and clearly the presence or absence of windows is not germane to any issue of patentability herein. The panels **12** are of slightly different configuration than panels **10** and **11** because of factors which will be discussed later.

The base or floor of the building of FIGURE 1 and FIGURE 2 are a square and a hexagon respectively which, in the exemplification being described, are eight feet on the side, though they may of course be of any other suitable dimension. The structure of the floor or platform per se will be described below but is passed over for the moment in favor of describing the side walls and roof of the structure.

Referring to FIGURE 6, a panel **10** is shown from the inside where it is seen that the panel is bounded by structural elements **13**, one along each side of an isoscles triangle. While the scantlings of the elements are not specifically germane to the issue of patentability, a frame element **13** of 1″ x 4″ dimension has been found to be useful, the 4″ face being applied flat against a plywood panel element. Along one edge which as will appear later will be the lower edge of this panel **10**, is a flashing element **14** which may be of any suitable material, and aluminum is suggested as a flashing material. Along the three edges of panel **10**, connecting elements **15** are mounted. Elements **15** are similar to a hinge. The connecting elements are shown in detail in FIGURES 12, 13 and 14, and will be described below in referring to these specific figures.

Referring to FIGURE 7, we see a panel **11** which is formed of a sheet of plywood of similar thickness and of the same configuration as that used for panel **10**. Panel **11** is bounded by strips **16** which may conveniently have a scantling of 2″ x 3″, and to which connecting elements **15** are also secured that are preferably both identical to and complementary to the elements **15** secured to frame element **13** of FIGURE 6. Frame elements **16** are applied with their 3″ wide faces against the plywood. On two edges of panel **11**, a flashing **17** is provided which, as will be seen below, will overlap the edges of the adjacent panels **10**.

Roof panels **12** differ from the panels **10** and **11** because they have preferably more acute apex angles to form the peak of the roof. Along one edge of a triangle there is a structural element **18** which may conveniently be a piece of 2″ x 3″ wood with its 2″ face toward the plywood of the panel itself. The plywood of the panel may extend in one direction, below element **18** in FIGURE 5, to form overhanging eaves for the building. From the two ends of element **18** the panel extends upwardly to an apex of 58° and is conveniently bounded by a piece of 2″ x 3″

wood designated as **19** along each edge with the 2" faces of the pieces against the panel. A flashing or rain apron **20** extends along one side of each panel **12**. Panel **12**, like panels **10** and **11**, is provided along each edge with connecting elements **15**.

The arrangement of the elements **15** on the panels is in a manner of dynamic symmetry so that the elements **15** will not fail to be properly located to fall adjacent the complementary element **15** of an adjacent panel.

Regardless of the size of the building to be erected, the sides **13**, **16** and **18** of the set of panels from which the building is to be erected must be equal. The placing of the element **15** on panels **10**, **11** and **12** are such that, in the set, any panel **10** will be connectable along its side to any panel **11**, and any panel **11** will also be connectable along its upper edge to the edge **18** of any panel **12**. And, any panel **12** will, of course, be connectable to any adjacent panel **12**.

It will be noted that the elements **13** are slightly thinner than the elements **16** because it is desired to have the flashing **17** lie outwardly of the panels **10**. No interference, however, will occur if the elements **13** are of the same dimension and positioned exactly as the elements **16** are positioned. The reason for having the 2" x 3" element **18** lie edgewise whereas the 2" x 3" element **16** lies flatwise is illustrated in FIGURES 8, 9, 10 and 11, which show sections of an assembled house of triangular, square, pentagonal, and hexagonal, respectively, taken at the juncture of the roof panel **12** and the side panel **11**. It is clear from FIGURES 10 and 11 that in these exemplifications the element **18** could be equally well placed flatwise against the panel **12**, where pentagonal or hexagonal buildings only are contemplated.

FIGURE 15 shows a schematic layout for a triangular building according to the present invention. In this case it is clear that the triangular floor **21** will have three panels **10** connected to it, one along each side of the equilateral triangle **21**. A side panel **11** will be mounted and secured to each side panel **10** so that the upper edge of the side panels **11** form an equilateral triangle which is rotated 60° with respect to floor triangle **21**. Each upper edge of a side panel **11** will be secured to a roof panel **12** and each roof panel **12** will be secured to two adjacent roof panels to form a triangular pyramidal roof.

In case of a square floored building, there will be four side panels **10**, four side panels **11**, and four roof panels **12**. The base or floor of such a square building will be square having sides equal to side **13** of the side panels **10**. The platform for a square building may be a single piece or may be made of two or more triangular pieces. A square building is shown in FIGURE 1.

Where a hexagonal building is desired, which is shown in FIGURE 2, six panels **10**, six panels **11** and six panels **12** will be required. Clearly, one of the panels **10** in any building should include a door, or entry, and, if desired, any of the panels **11** may be provided with windows.

It will be noted that the device of the present invention will be of use even without a platform or floor, in which case, panels **10** and **11** are merely secured together edge to edge, stood up in generally vertical position, and the roof panels **12** secured to the top edges of panels **11** and to each other.

For the triangular or square building a triangular or a square base may be prefabricated as a unit or may be formed of a plurality of subassemblies and appropriate securing elements **15** mounted along the upper outer edge of the base. FIGURE 3 shows a suggested manner of forming a floor platform for a pentagonal building which is broken down into five triangular elements and one trapezoidal element which would be comparatively light, of small dimension, easily stowed, packed, and carried. In this case, two joist elements **22** are provided to carry the floor load to appropriate corners of the pentagonal floor. Since the method of supporting the joist elements in FIGURE 3 is the same as for the joist element in FIGURE 4, the support will be described in connection with FIGURE 4, taken with FIGURES 16, 17, 18, 19 and 20.

From FIGURE 20 we see that a two-story building may be erected using the elements of the present invention. The side wall panels **10** and **11** that form the walls of the second story of the building are exactly like panels **10** and **11** which are used for the lower floor of the building. Referring to FIGURES 16 and 17, it will be seen that there may be a joist element **22** which is also seen in FIGURE 4 extending directly across the center of the hexagonal building.

In a single story building it is only necessary to support the ends of joist element **22** and to support the other four corners of the hexagonal building on piers of some sort. In making the two-storied structure of FIGURE 20, however, it is necessary to support the floor for the second story from the periphery of the upper edge of the side walls of the lower story. This is done by providing fastening elements **15**, similar to the fastening elements **15** on the other panels, on the marginal edges of each floor panel **23** of a hexagonal building. As seen in FIGURE 16, these securing elements **15** at the bottom edge of the marginal strength elements **24** of a floor panel will be positioned so that they may readily be connected to the element **15** on the upper peripheral edges of panels **11** of the lower floor of the building. A special joist hanger **25** is provided which has loops **26** at each end arranged so as to lie in alignment with and immediately adjacent the connecting element **15** as seen in FIGURE 18. Preferably a wooden block seen in FIGURES 16 and 17 is mounted on the element **25** to rigidify the device and to distribute the load more effectively, and providing connections between hanger **25** and loops **26** long enough to be twisted if necessary for use in other buildings.

A common pin **27***a* connects the elements **15** on panel **11**, element **15** on peripheral strength element **24**, and the joist hanger **25**. The difference in angle required between loops **26** in a pentagonal building from that in the hexagonal building would be attained by reforming the hanger as by a hammer.

In erecting the building, after the side panels **10** and **11** of the lower floor have been erected, the joist **22** may be put in position extending across the building and resting on the joist hangers **25** at each end. The joist may be spiked or bolted to the joist hangers. The floor panels **23** and **23'** on each side of the joist may then be bolted to the joist after they have been secured by their elements **15** to the top edges of the lower panels **11** and similarly floor panels **23"** will be bolted to the adjacent panels **23** and **23'**, respectively, on each side of the building.

At the top edge of each of the panels **23**, **23'**, **23"**, there are elements **15** to which the panels **10** of the upper floor of the building are to be secured and are to be erected with panels **11** in the same manner that the lower wall panels **10** and **11** were assembled on the lower floor platform which was erected on piers. Roof panels **12** are then assembled to roof over the upper floor of the building.

There are minor differences in the exact proportioning and shape of the panels **23**, **23'** and **23"**, which are immediately apparent upon inspection of FIGURES 16 and 17, taken with FIGURE 4, due to the interposition of the joist **22** between the two halves of the floor platform. Where only single story buildings are contemplated, a central pier could be used with identical equilateral triangular floor panels.

FIGURE 21 shows diagrammatically a single floor building made according to the present invention which may be moved by a crane at a construction site or since, when empty, a building using 8 foot equilaterial triangular panels will weigh about 2500 pounds, such a building may be moved by helicopter if necessary. In this case the central element **30** is a steel pipe, or the like, that ties the floor to the roof.

FIGURES 12, 13, and 14 show plan, elevation and section, respectively, of securing elements **15**. Each ele-

ment **15** has a leaf portion **15***a*, and an eye or gudgeon **15***b* to receive a pintle **27**. The axis of the pintle when in place is at the corner of the building element on which the securing means **15** is mounted in order that, as assembled in buildings of differing numbers of sides the space between the panels secured by the elements **15** will always be minimal. This is illustrated in FIGURES 8, 9, 10 and 11, where, in assembling roof panels **12** to side wall panels **11** for each of the buildings suggested, the spacing between elements **16** and **18** is very small as these elements are held in corner-to-corner relationship.

In extremely cold climates the panels may include insulating material and the joints between adjacent panels may be packed. There will always be a wedge-shaped space between adjacent panels, except for the joint of FIGURE 8 between panels **11** and **12**, which is tight to the degree that it illustrates the desirability, if three-sided buildings are to be erected, of providing relief between elements **16** and **18** to avoid straining the panels. The flashing or rain apron over the joints between adjacent panels will help retain any packing provided. It is noted that a flashing or rain apron may be used in lieu of or in addition to the extension of the panel below element **18** in FIGURE 5 to carry water over the joint between panels **11** and **12** and over the top ends of flashing **17**.

I therefore claim:

1. Articulated building modules comprising sets of three panels, adapted to form, with a plurality of similar sets of three panels, the side walls and roof of a quickly assembled building, said set of panels including a first panel of isosceles triangular shape its base disposed downwardly, and its upwardly pointing apex angle defined by the other two sides of said panel, at least two half hinge-like securing means mounted on each of said other two sides, a second panel of isosceles triangular shape equal to the said first panel, said second panel being provided with a rain apron along each of its two sides adjacent to its apex angle, complementary half hinge-like securing means on each side of said second triangular panel positioned identically on each said side cooperating with said half-hinge like securing means on either side of said first panel whereby said first and second panel are secured together, and said second panel may be secured to another first panel securing said panels the apex of said second panel pointing downwardly and located adjacent to the base of said first panel and the rain apron along the side of said second panel connected to said first panel and overlying said first panel, and a third panel of isosceles triangular shape its base being of the same length as the bases of said first and second panels, half-hinge-like securing means on each edge of said third panel, said third panel being secured base to base with said second panel and adapted to be secured side to side to other third panels when said set of panels is erected to form a portion of the side walls and roof of a building.

2. The structure of claim **1** in which said third panel has a portion extending from its base to form an eaves.

3. The structure of claim **1** in which the apex angle of said third panel is more acute than the apex angles of said first and second panels.

4. The structure of claim **1** in which said first panel is provided with a rain apron along its base.

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