May 18, 1965 W. W. NIGHTINGALE 3,184,014

BUILDING CONSTRUCTION

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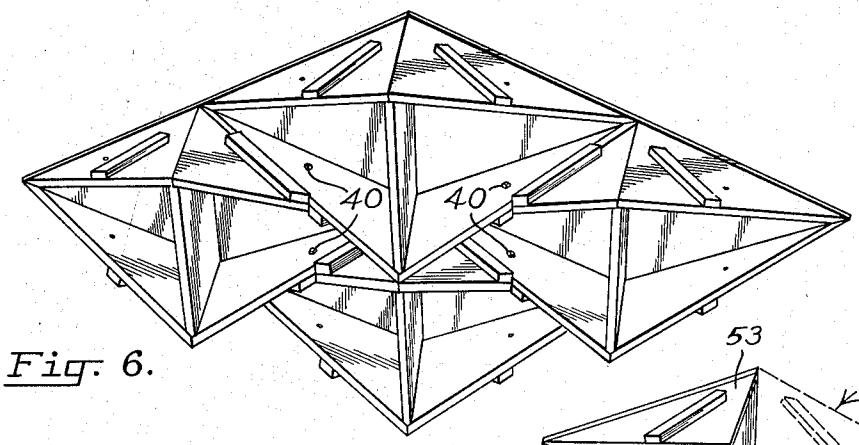

Fig. 6.

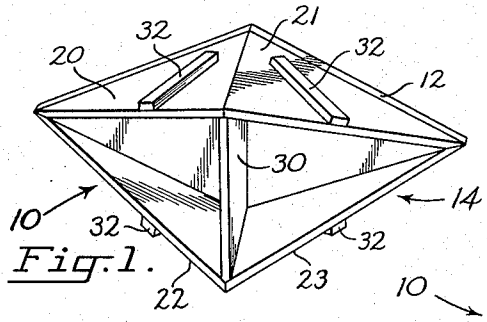

Fig. 1.

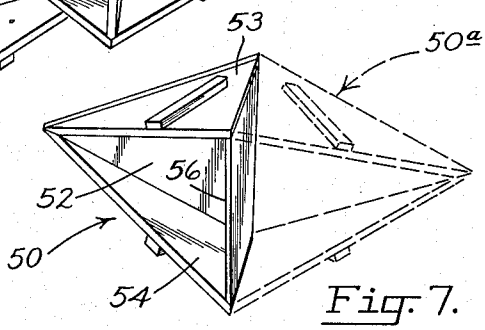

Fig. 7.

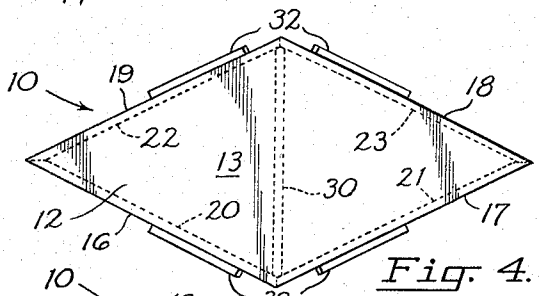

Fig. 4.

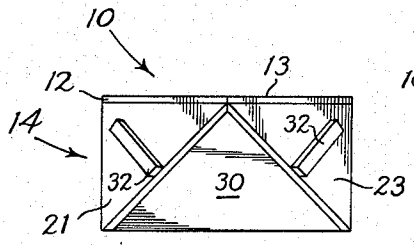

Fig. 3.

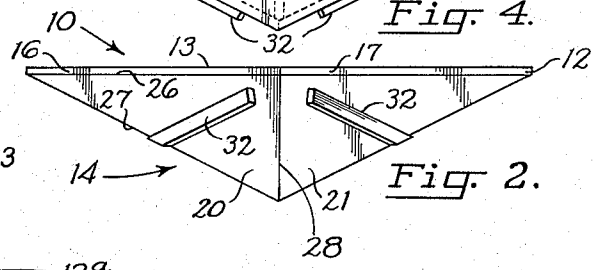

Fig. 2.

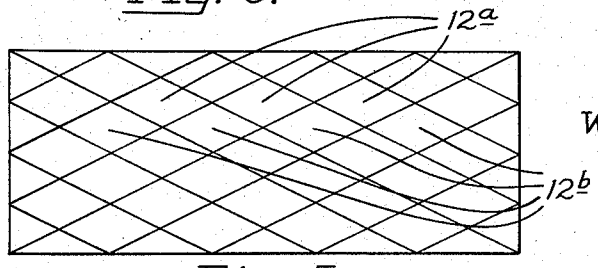

Fig. 5.

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Fig. 10.

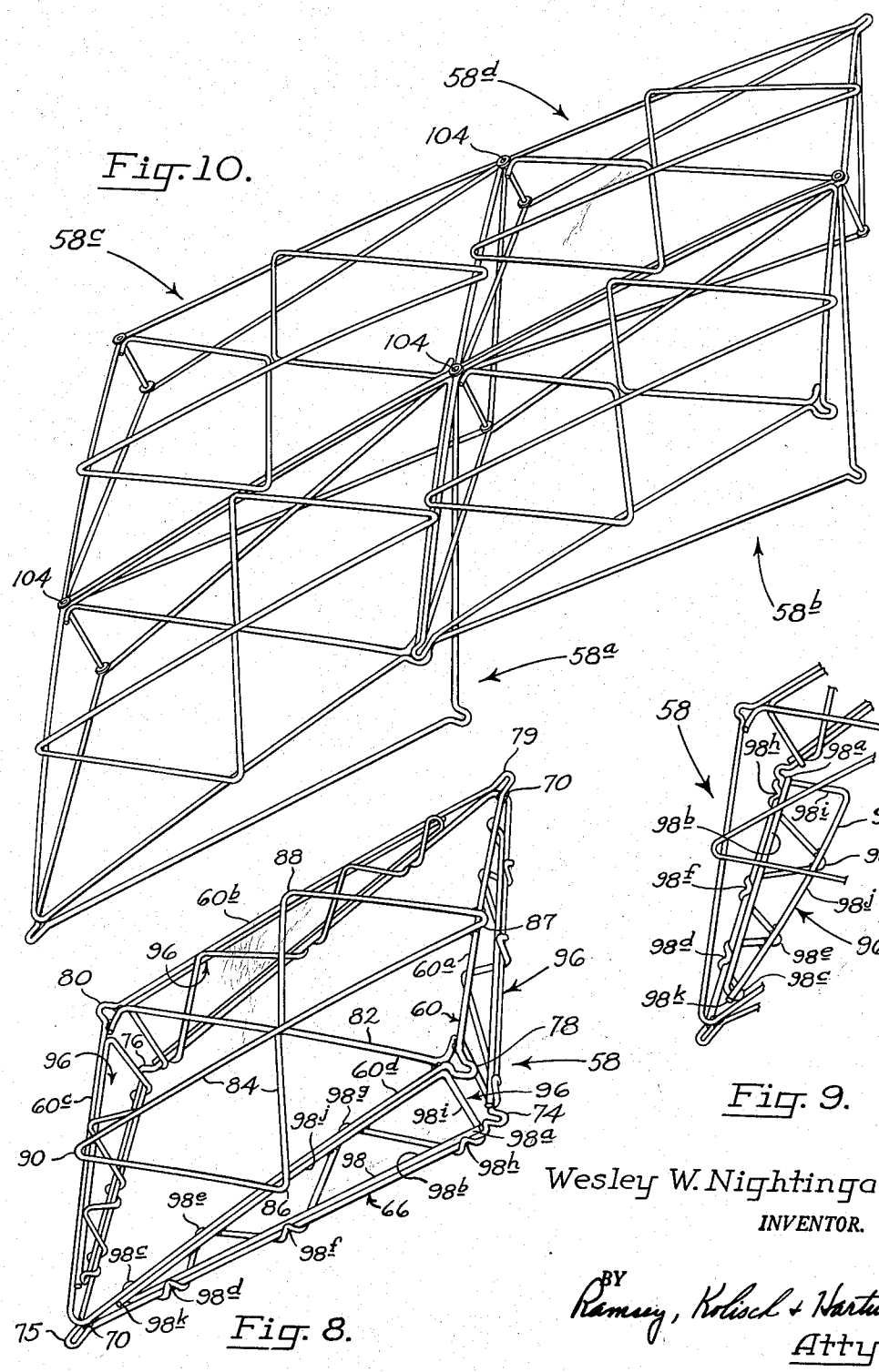

Fig. 8.

Fig. 9.

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United States Patent Office 3,184,014 Patented May 18, 1965

3,184,014

BUILDING CONSTRUCTION

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Filed Feb. 9, 1962, Ser. No. 172,258
8 Claims. (Cl. 189—34)

This invention relates to the building arts, and more particularly to a novel type of building structure, comprising plural building components suitably secured together in the structure. The invention concerns the novel construction of the building structure as a whole, and also the novel construction of the components that may make up the building structure.

In the erection of a building, it has become increasingly the tendency to prefabricate portions of the building, thus to simplify its ultimate construction. The use of prefabricated parts tends to decrease labor costs at the building site. In certain types of buildings, the use of preassembled components may have the advantage of enabling the building to be dismantleable. That is to say, a building comprised of plural easily disconnected components may be set up at one location, and at some later date be broken down and transported to another location when such is desired. This invention more particularly concerns improvements in such types of buildings, and the components used in their assembly. Certain features of the invention, however, have importance in other, more general types of buildings.

Generally, it is an object of the invention to provide an improved building structure having a high degree of strength and rigidity, in relation to the strength of the materials used in its construction.

A triangle as is known is a rigid self-sustaining structure. A feature of the building structure of the invention is the inclusion in the structure of multiple, triangular shaped truss structures, imparting rigidity and strength thereto.

Another general object is to provide an improved building structure that may be fabricated to a large extent from paneling, such as readily available plywood, for example.

A still further object of the invention is to provide a novel building structure that comprises plural building components organized in such a fashion as to enable the components easily to be assembled into the completed building structure.

Two different embodiments of the invention are particularly disclosed herein. In both embodiments, building components are described comprising face structure defining a face for the component, ordinarily of quadrilateral outline and bounded by four margins of substantially equal length. The components when secured together in a completed building structure, are disposed in rows, with the components in a row being aligned in a direction extending diagonally of their faces. The componetnts in a row are also staggered with respect to the components of adjacent rows. Each component is provided with truss structure, making it rigid, and also cooperating with the truss structures of adjacent components to provide a supporting framework for the completed building structure. The construction is such that in a completed building structure, triangular-shaped truss structures extend at acute angles relative to the rows of components in the building structure. Such truss structures, therefore, are operable to make the building strong, in directions extending both laterally and longitudinally of the rows.

The truss structure provided in a component is unique, in that a high degree of strength is imparted to the component in relation to the size of the truss structure and the strength of the materials therein. It is contemplated that triangular panel sections make up the truss

structure, and that such be mounted with the same disposed in planes normal to the face of the building component, and ordinarily paralleling the four margins thereof. In such a manner, the strength of the truss structure is concentrated at locations in the building component where it is most needed.

Various other novel objects and advantages of the invention will become more fully apparent, as the following description is read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a building component constructed according to one embodiment of the invention;

FIG. 2 and 3 are side and end elevations, respectively, of the component in FIG. 1;

FIG. 4 is a top, plan view of the building component illustrated in FIGS. 1, 2, and 3;

FIG. 5 is a view, drawn on a somewhat smaller scale, looking down on the flat, top surface of a structure produced from the building components;

FIG. 6 is a perspective view, drawn on substantially the same scale as the one used in FIGS. 1–4, of the underneath of portions of the building structure shown in FIG. 5;

FIG. 7 illustrates, in perspective, a modified form of construction for a building component;

FIGS. 8 and 9 are perspective views of still another modification of the invention; and

FIG. 10 is a perspective view of portions of a building structure, such as may be built from the components shown in FIGS. 7 and 8, with parts removed for reasons of clarity.

Referring now to the drawings, and first of all in particular to FIGS. 1–5, **10** indicates generally a building component, as contemplated by one modification of the invention. The component is one that may be used, for instance, in constructing a flat floor, or if inverted, a ceiling. In general terms, building component **10** comprises a facing panel or means **12**, defining an outer face **13** for the component, which in this instance is flat. Mounted beneath panel **12**, and provided for the purposes of making the component and the building into which it is incorporated strong and rigid, is truss structure, indicated generally at **14**.

Panel **12** may be of any suitable material. For instance, it may be an imperforate sheet of plywood or other material. Particle boards are readily available and may be used. If an imperforate sheet is used, a continuous flat surface results in a building made from the components, which is sometimes advantageous. As can be seen with reference to FIG. 4, the panel has a quadrilateral outline, and is bounded by four margins of equal length, indicated at **16**, **17**, **18**, and **19**.

Truss structure **14** on the underside of panel **12** comprises a series of truss or panel sections, indicated at **20**, **21**, **22**, and **23**. Each in the embodiment shown comprises a triangular piece mounted alongside and paralleling one of the margins **16-19** of panel **12**.

Each truss or panel section lies in a plane that is normal to the plane of the face of panel **12**. Further, each truss or panel section has a margin (such as margin **26** for panel section **20**) paralleling a margin of panel **12** (margin **16** in the case of panel section **20**,) another margin (margin **27** for panel **20**) connected at one end to the first-mentioned margin, and diverging from such margin progressing along its length, and a thrid margin (margin **28** for panel **20**) connected at its ends to the first-mentioned pair of margins that is parallel to the corresponding margin in an adjacent truss or panel section. The panel sections may be secured in a suitable manner (as by gluing) to the underside of panel **12**. In the building component, they provide triangular bracing struc-

ture beneath the component. They also provide a means which the component is secured to adjacent components in a completed building structure, as will be described.

If desired, an intermediate panel **30** may also be included in truss structure **14**. As shown, panel **30** has one edge against the bottom side of panel **12**, and end edges abutting against margins of panel sections **20–23** and holding the panel sections apart at the middle of the building component.

Completing the description of the building component, on the outer faces of the panel or truss sections, there may be provided a series of strips, indicated at **32**. The strips are employed in fitting plural building components together in a building structure.

In erecting a structure such as a floor, illustrated in plan in FIG. 5, the various building components are placed in parallel rows, with the components of one row (such as components **12***a* in FIG. 5) staggered with respect to the components of an adjacent row (such as components **12***b* in FIG. 5). In each row, the components are aligned in a direction extending diagonally across the outer faces of the components. In FIG. 6, the underside of a portion of the structure shown in FIG. 5 is illustrated. The manner in which the various components are interfitted together should be clear from referring to the figure. In a completed building structure, the components of adjacent rows are fastened together, as by fasteners **40**, that extend through and secure together adjacent truss or panel sections of the underlying truss structure.

As can also be seen, with reference to FIGS. 5 and 6, in a completed building structure the components are, in a manner of speaking, locked together, to inhibit relative lateral shifting of the rows, because of the staggered relationship and the diagonal positioning of the components. On the underside of the structure, interlocking truss structure is formed, with each component supported by its own truss structure and also by truss structure of adjacent components. Particularly important, it should be noted that the various truss or panel sections are disposed at acute angles relative to the longitudinal axes of the rows containing the components. As a result, the building is braced by triangular truss or panel sections in directions extending both longitudinally and transversely of the rows.

Various modifications of the invention are possible, and some of these will now be discussed.

Referring to FIG. 7, here a building unit **50** is illustrated, which resembles one-half of component **10** illustrated in FIG. 1. That is to say, the unit resembles either of the two portions of component **10** that would result if the latter component were cleaved along a plane passing through the middle of intermediate panel **30**.

Unit **50** includes a top panel **52** (of triangular outline) and truss or panel sections **53**, **54** (in the form of triangular pieces) secured to the underside of panel **52**. At **56** is indicated a cross panel, secured to the underside of panel **52**, and spanning the space between panel sections **53**, **54**.

Unit **50** may be placed against another similar unit, such as the one indicated at **50***a* and shown in dashed outline in FIG. 7. If the cross panels of the two units are then secured together, a component results that is similar to component **10** already discussed. Such a component may then be used to make a complete structure, substantially in the same manner as component **10**.

FIGS. 8, 9, and 10 illustrate a still further modification of the invention. In this instance, the building component (illustrated in FIG. 8 in perspective and indicated at **58**) comprises a series of skeletal panel sections, also referred to as frame sections, suitably secured together.

Referring again to FIG. 8, instead of imperforate panel **12** present in the first embodiment, there is provided an elongated, continuous, metal rod (or facing structure) **60**, extending in reaches **60***a*, **60***b*, **60***c*, and **60***d*, so as to define a face for the component of quadrilateral outline, bounded by four margins of substantially equal length. Along the underside of rod **60** is a rod **66**, providing a border or mounting portion. Rod **66** is shaped to have a quadrilateral outline substantially matching the outline of rod **60**.

Rod **66** is secured, as by welds **70**, to the facing structure thereabove. The connection is between corresponding corners of the border portion and facing structure, at one set of oppositely disposed corners of the border portion. The border portion between its points of joinder with the facing structure is free of, and yieldable relative to, the facing structure.

Border or mounting portion **66** is provided at three of its corners with U-shaped portions **74**, **75**, **76**. Similarly, rod **60** of the facing structure is provided at three of its corners with U-shaped portions **78**, **79**, and **80**. These are used in attaching the components with other components in a completed structure.

A transverse bar **82** extends between opposite corners of the facing structure, and this bar has turned-over ends that close off U-shaped portions **78** and **80**. The same bar is welded adjacent its ends to the facing structure, thus to secure it in place. Also part of the facing structure is a bar **84**, with the outline of a figure eight, having portions **86**, **87**, **88**, and **90** adjacent its corners fastened to reaches of rod **60**.

The modification of the invention now being described is particularly useful when it is desired to ship the components in a compact form, and then finally assemble them as a construction site. The component, therefore, is provided with detachable spreaders, in the form of triangular-shaped panel sections, indicated at **96**, that may be fitted into place alongside each margin of the face of the building component, and used to spread apart parts of the border or mounting portion therebelow.

In FIG. 9, where a part of a component **58** is shown, part of such a spreader portion is shown, with the same partially in place and before being swung into final position on the component. As can be seen with respect to this figure, and also FIG. 8, each spreader comprises a rod **98** bent as follows: From an end **98***a* of the rod, the rod extends along a reach **93***b* to a turn **98***c* (which defines a hooked portion); from turn **98***c*, the rod progresses thence to define a hooked portion **98***d*, a corner **98***e*, a hooked portion **98***f*, a corner **98***g*, and a hooked portion **98***h*; from thence the rod extends in a reach **98***i*, and after a turn extends in a reach **98***j*, whence it terminates at an end **98***k*. End **98***a* is secured to the rod adjacent hooked portion **98***h* (as by welding), and end **98***k* is secured to turn **98***c* (as by welding). Reach **98***j* may also be fastened to corners **98***e*, **98***g* (as by welding). The result is a rigid, wedge-shaped piece.

A spreader of the type described is mounted in position by placing hooked portions **98***d*, **98***f*, **98***h* around a reach of the border portion. The spreader may then be swiveled upwardly, from the position shown in FIG. 8, to a position where reach **98***j* has moved under a reach of overlying rod **60**. Reach **98***j* is, in a manner of speaking, swung overcenter relative to the adjacent reach of rod **60**, until corners **98***e*, **98***g* strike rod **60**. When finally positioned as in FIG. 8, the spreader is held firmly in place, in a position substantially perpendicular to the face defined by rod or facing structure **60**.

In spreading the border or mounting portion from the facing structure, some elongation occurs in the border portion, but such is accommodated by U-shaped portions **74**, **76**, which tend to spread. Elongation in the facing structure is prevented by bar **84** and bar **82** discussed above.

In FIG. 10, a completed building structure is shown, made from plural components of the type just described. (In FIG. 9 the various spreaders have not been illustrated in order to simplify the drawing.) Referring to FIG.

10, here components 58*a*, 58*b* 58*c*, and 58*d* are mounted, with components 58*a*, 58*d* in a row (and aligned diagonally of their faces), and components 58*b*, 58*c* on either side. Securing the components together (through their truss structures) are pins, such as pins **104**, extending through U-shaped portions of the facing structure and border portion.

As in the case of the modifications discussed earlier, the completed structure in FIG. 10 has triangular-shaped truss structures disposed at acute angles relative to the longitudinal axis of a row of components. The triangular-shaped truss structures brace the components in the building, in directions extending both transversely and longitudinally of a row. The components interlock, and mutually support themselves, and form their own supporting framework.

It should be obvious from the above that the building components contemplated possess several advantages. The components provide a practical means for building a structure from preassembled parts.

While various modifications of the invention have been discussed, changes may be made in the components, such as in their construction and/or in their arrangement, without departing from the invention. It is desired, therefore, not to be limited by the specific structures disclosed herein, but to cover all forms of the invention coming within the scope of the appended claims, that would be apparent to one skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. A building component comprising facing structure of quadrilateral outline defining an outer face for the component bounded by four margins, and truss structure opposite said outer face secured to said facing structure and making the component rigid, said truss structure including a border portion of quadrilateral outline in matching relationship with said outer face, means fixing corresponding corners of said border portion and said facing structure at one set of oppositely disposed corners of said border portion, said border portion between its points of joinder with said facing structure being yieldable away from the facing structure in a direction laterally of the plane of the face defined thereby, and detachable spreader elements interposed between the facing structure and yieldable part of said border portion holding the latter spread laterally from the facing structure.

2. The component of claim 1, where said border portion is extensible between its points of joinder with said facing structure.

3. The component of claim 1, wherein the spreader elements are triangular shaped panels.

4. A building component comprising facing structure defining an expansive face for one side of the component, and truss structure mounted over the other side of the component and making the component rigid, said truss structure comprising an elongated mounting extending alongside a margin of said face with portions at intervals spaced along its length joined to said facing structure, and a spreader panel lying in a plane substantially normal to said face interposed between the facing structure and said mounting between the latter's points of joinder with the facing structure.

5. A building component comprising facing means defining an outer face for the component of quadrilateral outline; said facing means comprising a first skeletal frame section, including a rod portion bounding the outer face of the component forming four margins therefor of substantially equal length; and truss structure joined to said facing means opposite said outer face making the component rigid; said truss structure comprising a panel section of triangular outline extending alongside each margin of said outer face, each of said panel sections lying in a plane substantially normal to said outer face; and comprising another skeletal frame section secured in place along part of said rod portion of said first skeletal frame section; said panel sections being positioned in the component so that each of said panel sections has one margin parallel to a margin of said outer face, another margin connected at one end to said one margin and diverging therefrom progressing along its length, and a third margin connected at opposite ends to said one and said other margins and substantially paralleling a corresponding margin in an adjacent panel section; said truss structure further including a second rod portion having a quadrilateral outline substantailly matching the outline of said rod portion in said facing means, which is joined to the facing means and secures the panel sections in place.

6. A building component comprising facing means defining an outer face for the component of quadrilateral outline; said facing means comprising a first skeletal frame section, including a rod portion bounding the outer face of the component forming four margins therefor of substantially equal length; and truss structure opposite said outer face making the component rigid; said truss structure comprising a panel section of triangular outline extending alongside each margin of said outer face, each of said panel sections lying in a plane substantially normal to said outer face; and comprising another skeletal frame section secured in place along part of the rod portion of the first skeletal frame section; said panel sections being positioned in the component so that each of said panel sections has one margin parallel to a margin of said outer face, another margin connected at one end to said one margin and diverging therefrom progressing along its length, and a third margin connected at opposite ends to said one and said other margins and substantially paralleling a corresponding margin in an adjacent panel section; said truss structure further comprising means joined to said facing means securing the panel sections in place in the component.

7. A building component comprising facing structure defining an outer face for the component of quadrilateral outline bounded by four margins of substantially equal length; and four substantially planar panel sections of right-angled triangular outline fastened to the facing structure so as to provide truss structure on one side of the facing structure supporting the facing structure; said panel sections being mounted in planes normal to the outer face of the component, with one extending along each margin of the component; each of the panel sections for a component having a first edge paralleling a margin of the outer face of the component, a second edge normal to said one edge substantially perpendicular to the outer face of the component, and a third edge inclined relative to said outer face interconnecting said first and second edges; said panel sections being arranged in two pairs on said one side of the component; the panel sections of one pair having their said second edges disposed parallel to each other in a region adjacent one corner of said outer face, and interconnected, whereby the two panel sections provide mutual support in said region; the panel sections of the other pair having their said second edges disposed parallel to each other in a region adjacent another corner of said outer face which is opposite said one corner, and interconnected, whereby the two panel sections provide mutual support in this second-mentioned region; said panel sections while providing truss structure for the facing structure also accommodating the attachment of the component to other components in a completed building.

8. A building component comprising a substantially flat-faced and imperforate facing panel defining an outer face for the component of quadrilateral outline bounded by four margins of substantially equal length; and truss structure mounted on one side and secured to the facing panel making the component rigid; said truss structure comprising a truss panel of right-angled triangular outline extending along each margin of the facing panel; said truss panels being mounted in planes normal to the

outer face of the component; each of the truss panels having a first edge paralleling a margin of the outer face of the component, a second edge normal to said first edge and substantially perpendicular to the outer face of the component, and a third edge inclined relative to said outer face interconnecting said first and second edges, said truss panels being arranged in two pairs on said one side of the component; the truss panels of one pair having their said second edges disposed parallel to each other in a region adjacent one corner of said outer face, and interconnected, whereby the two truss panels provide mutual support in said region; the truss panels of the other pair having their said second edges disposed parallel to each other in a region adjacent a corner of the outer face disposed opposite its said one corner, and interconnected, whereby the two truss panels provide mutual support in this second-mentioned region.

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