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(54) **BUILDING STRUCTURE AND COMPONENTS THEREOF**

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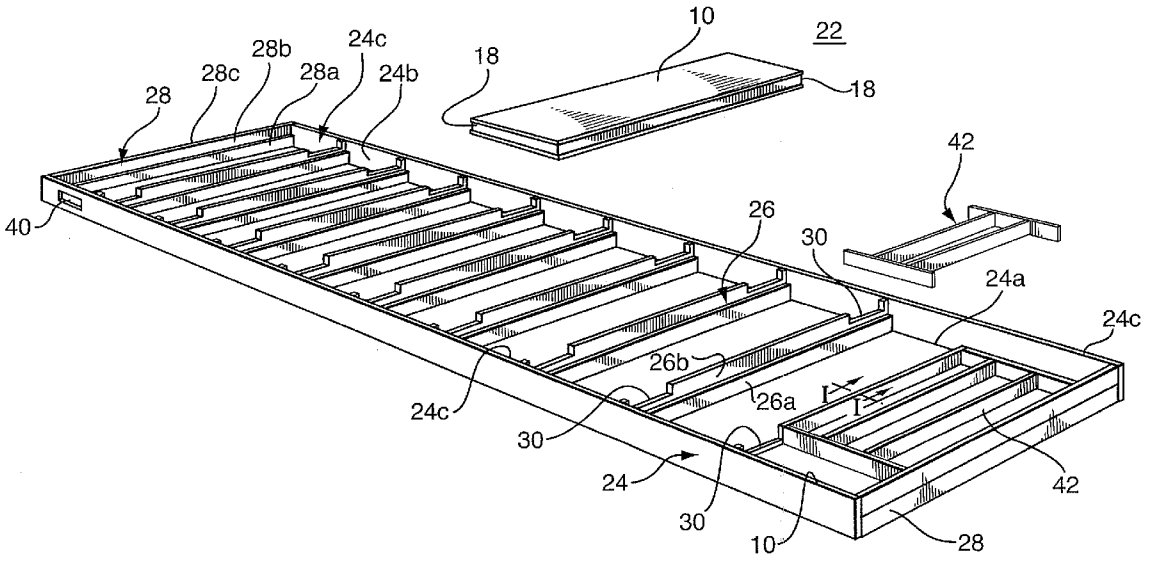
(57) **ABSTRACT**

Building components and building structures including structurally insulated panels and cavities for accommodating building services, which cavities are insulated and vapor sealed. The cavity is formed by providing cross beams that accept connection therebetween of structurally insulated panels on one end, but include portions that extend beyond the surface of the structurally insulated panels to accept structural sheating thereon. Building components are also taught that include keyed connections between cross beams and structurally insulated panels.



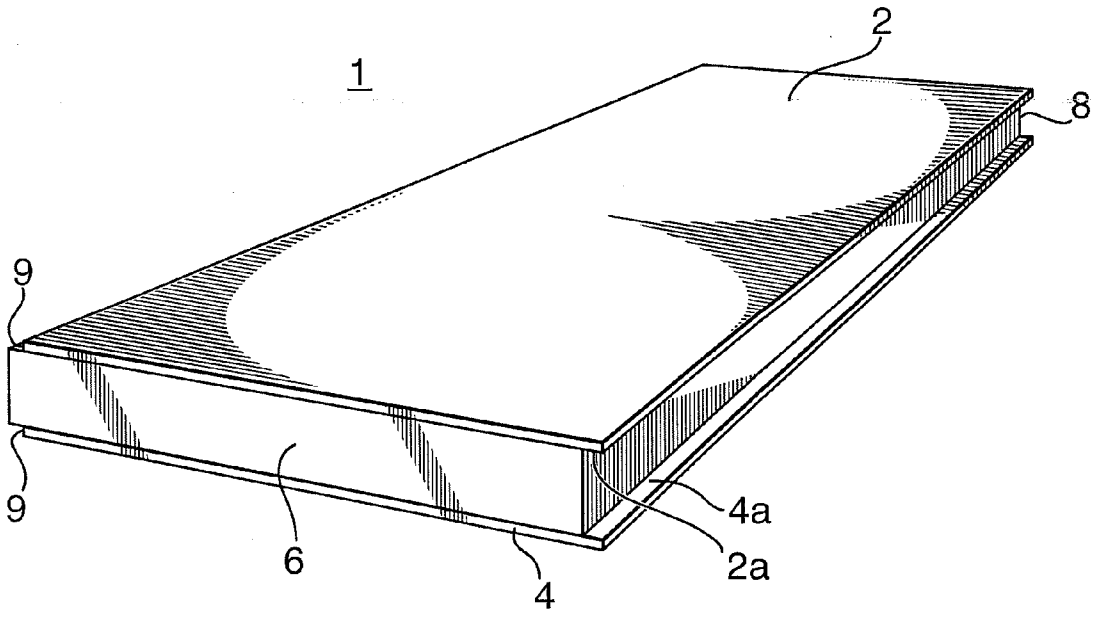


FIG. 1
PRIOR ART

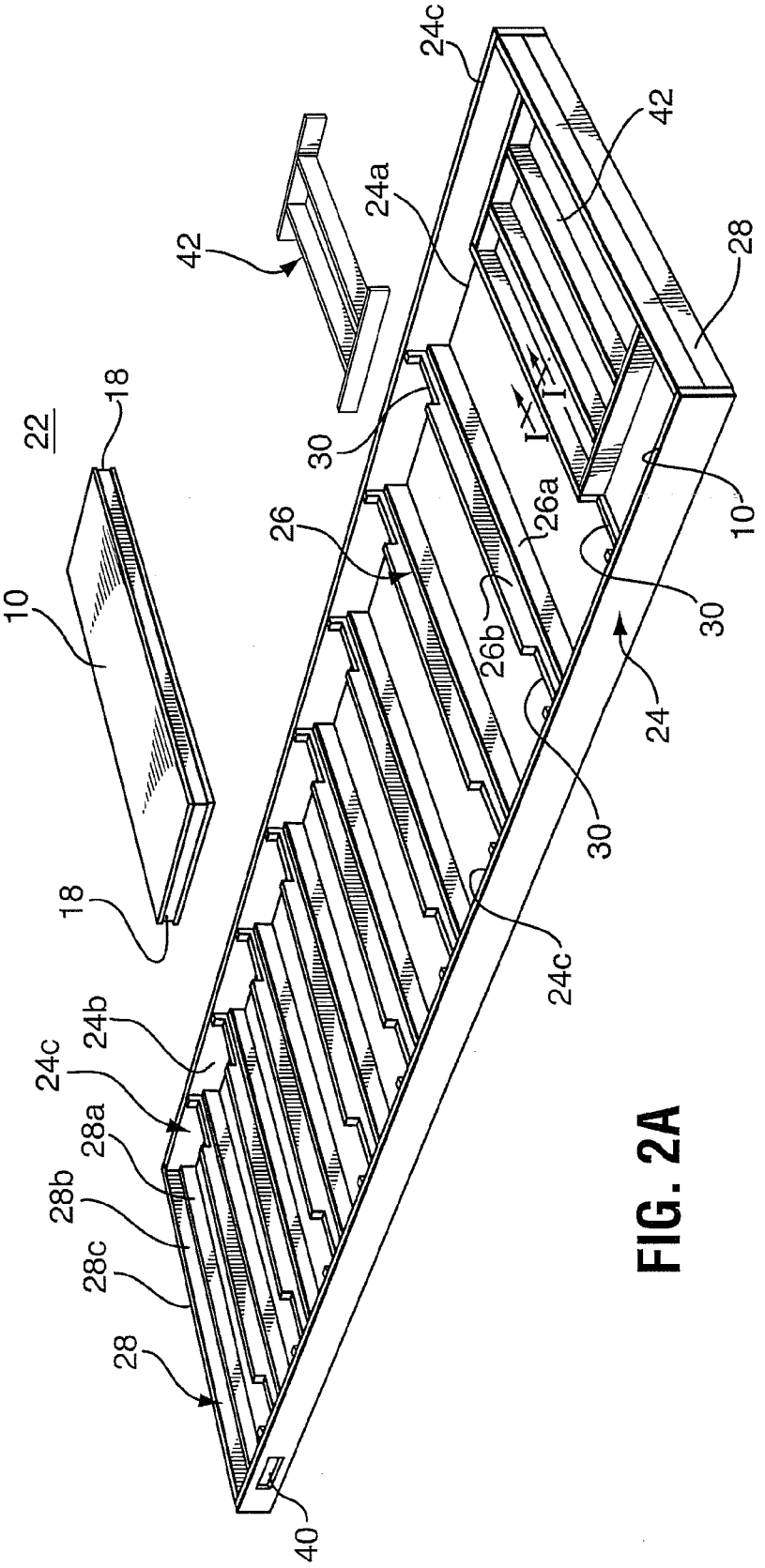

22
18
10
18
24c
24b
28a
28b
28c
28
40
42
24a
24c
42
28
30
26
26a
26b
10
30
24
30
24c

FIG. 2A

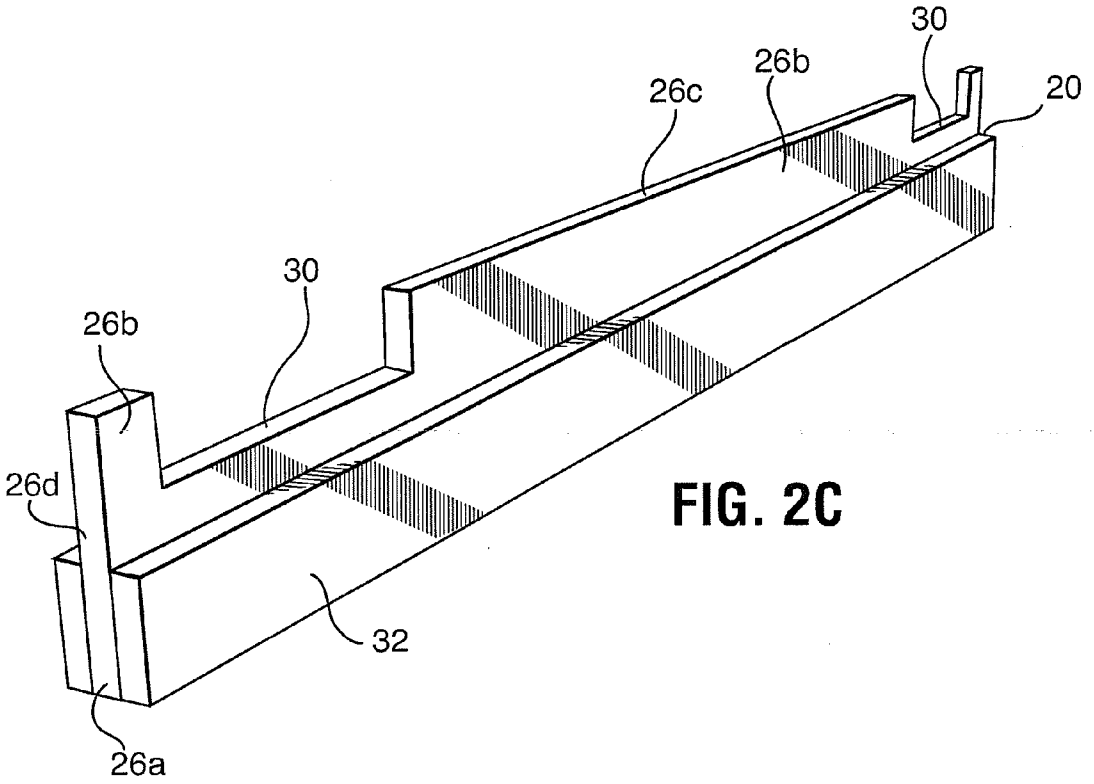

30
26b
26c
20
30
26b
26d
32
26a

FIG. 2C

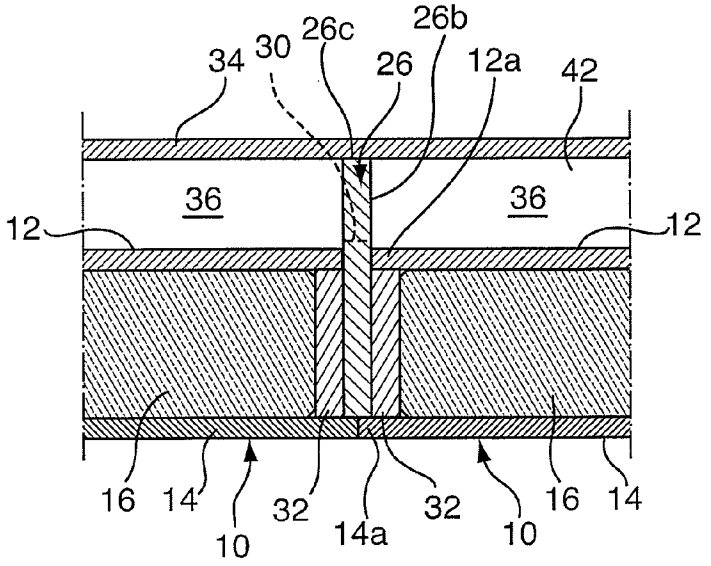

34
30
26c
26
26b
12a
42
36
36
12
12
16
14
10
32
14a
32
10
16
14

FIG. 2B

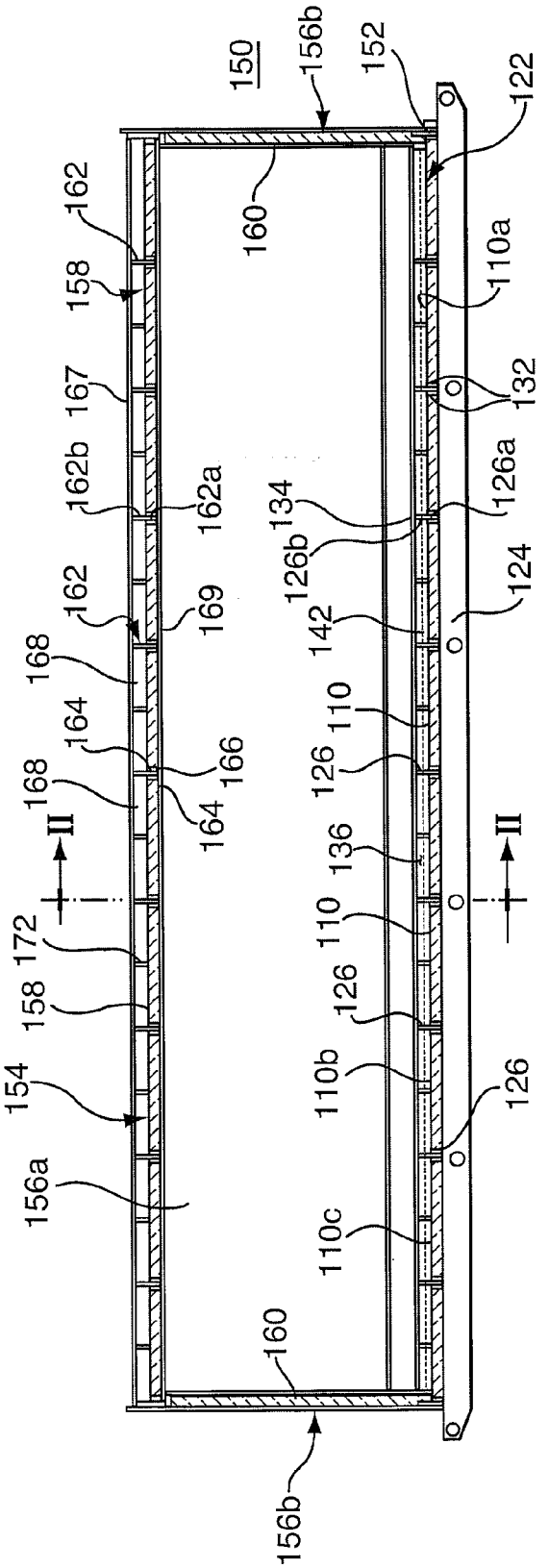

150
156b
152
122
160
110a
162
158
167
132
162b
162a
126a
134
126b
162
169
124
142
168
110
164
126
166
168
164
II
II
136
172
110
158
126
154
110b
126
156a
110c
160
156b

FIG. 3A

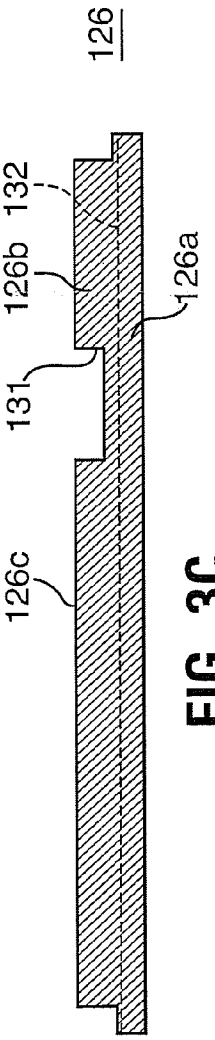

126
132
126b
126a
131
126c

FIG. 3C

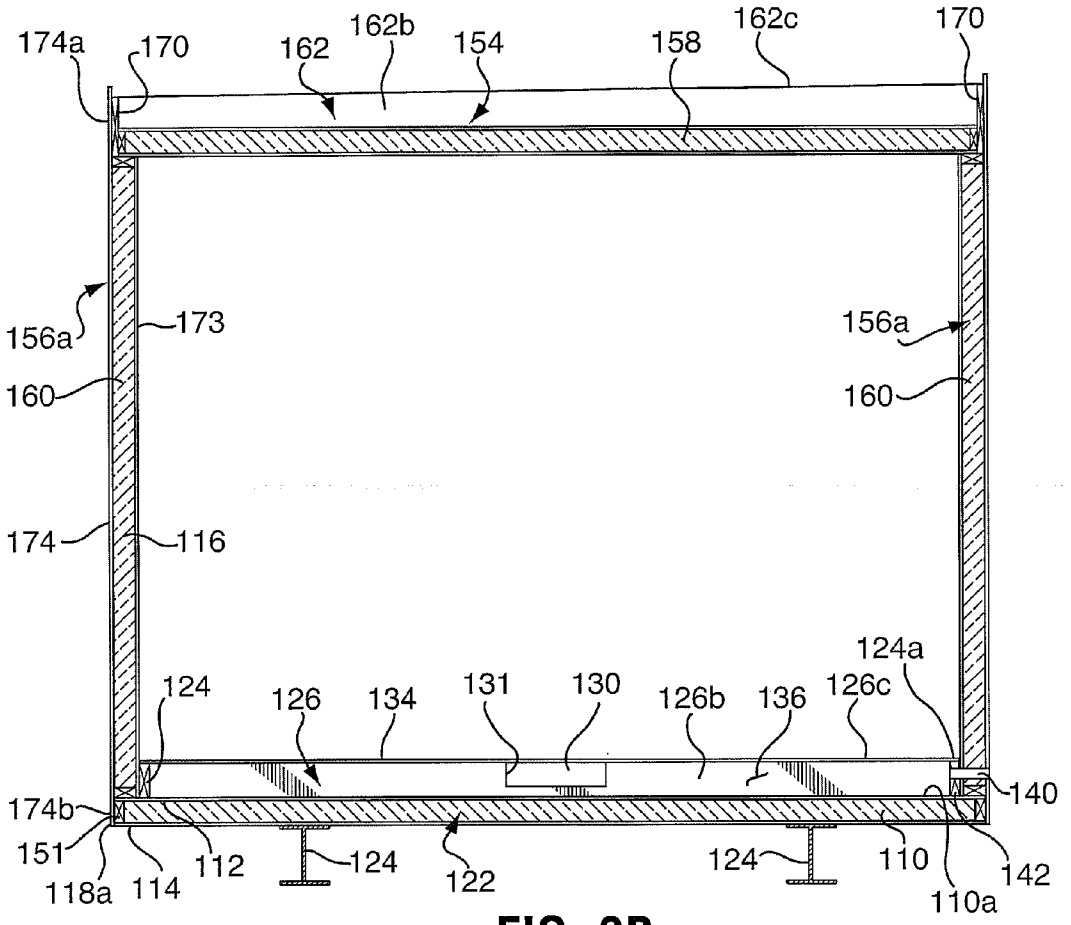

174a
170
162
162b
154
158
162c
170
156a
173
160
174
116
156a
160
124a
124
126
134
131
130
126b
136
126c
140
174b
151
118a
114
112
124
122
124
110
110a
142

FIG. 3B

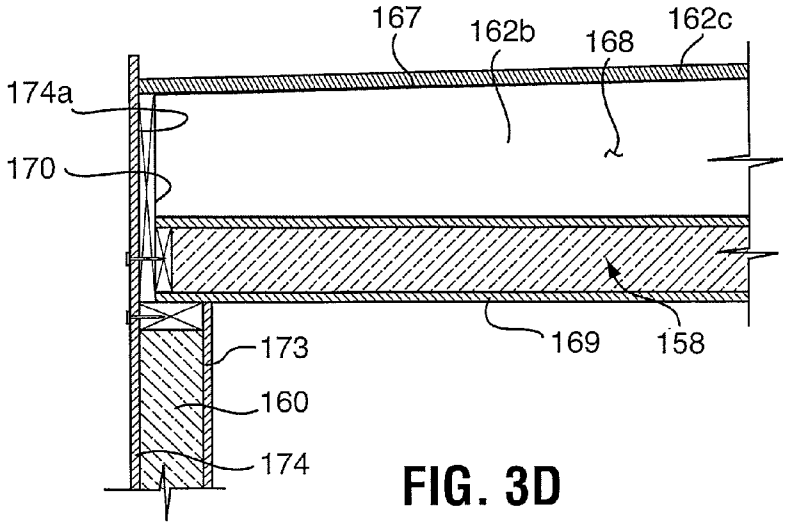

167
162b
168
162c
174a
170
169
158
173
160
174

FIG. 3D

BUILDING STRUCTURE AND COMPONENTS THEREOF

FIELD

[0001] This invention relates to building structures and components thereof and in particular to manufactured building structures and floor and roof components thereof.

BACKGROUND OF THE INVENTION

[0002] Manufactured building structures are useful in various applications such as residential housing, worker housing, school and office expansion and temporary or moveable sites.

[0003] An ongoing challenge of manufactured building structures is with respect to the construction of structures that offer manufacturing and transport capabilities of interest, while being within building code requirements. This is particularly true in manufactured building structures that are intended either directly or in a secondary application to be used as residential housing, since residential building codes may be more stringent than those for non-residential or dormitory type uses.

SUMMARY

[0004] A building structure and building components have been invented.

[0005] In accordance with a broad aspect of the present invention there is provided, a planar building component comprising: cross beams extending substantially laterally in the planar building component, the cross beams each including an upper portion with a top surface and a lower portion formed at least in part integral with the upper portion; at least one longitudinal support member each supporting at least a pair of the cross beams in relative position in the building component; structurally insulated panels, each including a lower sheet material layer, an upper sheet material layer and foam insulation therebetween, the structurally insulated panels being connected to the lower portions of the cross beams to span a space between adjacent cross beams, the connection between the panels and the cross beams leaving the upper portion of the cross beams protruding above the panels; and component sheathing installed above the top surfaces of the cross beams creating a cavity between the panels and the component sheathing.

[0006] In accordance with a broad aspect of the present invention there is provided, a building structure comprising: a horizontal building component including cross beams extending substantially laterally in the planar building component, the cross beams each including an upper portion with a top surface and a lower portion formed at least in part integral with the upper portion; at least one longitudinal support member each supporting at least a pair of the cross beams in relative position in the building component; structurally insulated panels, each including a lower sheet material layer, an upper sheet material layer and foam insulation therebetween, the structurally insulated panels being connected to the lower portions of the cross beams to span a space between adjacent ones of the cross beams, the connection between the panels and the cross beams leaving the upper portion of the cross beams protruding above the panels; and component sheathing installed above the top surfaces of the cross beams creating a cavity between the panels and the component sheathing; and a wall member extending substantially vertically from the horizontal building component.

[0007] In accordance with a broad aspect of the present invention there is provided, a planar building component comprising: cross beams extending substantially laterally in the planar building component, the cross beams each including an upper portion with a top surface, a lower portion and a protrusion extending from at least one side of the lower portion; at least one longitudinal support member each supporting at least a pair of the cross beams in relative position in the building component; structurally insulated panels, each including a lower sheet material layer, an upper sheet material layer and foam insulation therebetween, the lower sheet material layer and the upper sheet material layer extending out beyond the foam insulation to form a channel along a panel edge, the structurally insulated panels being connected to the lower portions of the cross beams to span a space between adjacent cross beams, the connection having the protrusion inserted between and connected to the lower sheet material layer and the upper sheet material layer; and component sheathing installed above the top surfaces of the cross beams creating a cavity between the panels and the component sheathing.

[0008] It is to be understood that other aspects of the present invention will become readily apparent to those skilled in the art from the following detailed description, wherein various embodiments of the invention are shown and described by way of illustration. As will be realized, the invention is useful for other and different embodiments and its several details are capable of modification in various other respects, all without departing from the spirit and scope of the present invention. Accordingly the drawings and detailed description are to be regarded as illustrative in nature and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Referring to the drawings wherein like reference numerals indicate similar parts throughout the several views, several aspects of the present invention are illustrated by way of example, and not by way of limitation, in detail in the figures, wherein:

[0010] FIG. **1** is a perspective view of a typical, prior art structurally insulated panel.

[0011] FIG. **2**A is a perspective view of a floor component partially in exploded configuration.

[0012] FIG. **2**B is a sectional view along line I-I of FIG. **2**A.

[0013] FIG. **2**C is a perspective view of a beam useful in the present invention.

[0014] FIG. **3**A is a longitudinal sectional view through a building structure.

[0015] FIG. **3**B is a sectional view along line II-II through the building structure of FIG. **3**A.

[0016] FIG. **3**C is a front elevation of a beam useful in the present invention.

[0017] FIG. **3**D is an enlarged view of the area shown in FIG. **3**B.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS

[0018] The detailed description set forth below in connection with the appended drawings is intended as a description of various embodiments of the present invention and is not intended to represent the only embodiments contemplated by the inventor. The detailed description includes specific details for the purpose of providing a comprehensive understanding

of the present invention. However, it will be apparent to those skilled in the art that the present invention may be practiced without these specific details.

[0019] FIG. **1** shows a structurally insulated panel **1**, such a panel typically including a first sheet material layer **2** and a second sheet material layer **4**, forming substantially outer side planar surfaces of the panel, and an insulating foam material layer **6** between the sheet material layers. The sheet material layers may be substantially rigid, for example, formed of wood (plywood, OSB, etc), metal, drywall, polymers, etc. The insulating foam may be of polyurethane, styrene, etc. Generally, the side and end limits of sheet material layers **2**, **4** may be offset from the side and end limits of the insulating foam layer to create overhanging portions **2***a*, **4***a* and/or recessed portions of the material such that grooves **8** are formed between overhanging portions and shoulders **9** are formed at the recesses. Such grooves **8** and shoulders **9** may be used to create interlocking joints, such as tongue-in-groove type joints, between adjacent panels and between a panel and other building members such as beams. For example, a side edge of one part may be inserted into a groove **8** formed in the panel and may be secured between overhanging portions **2***a*, **4***a*. A structurally insulated panel is hereinafter referred to as a SIP.

[0020] Structurally insulated panels (SIPs) may be used to construct a planar building structural component such as a floor, a roof or a wall. With reference to FIG. **2** in one embodiment of the present invention, a floor **22** may be constructed using SIPs **10**. While the floor may be useful in various structures, the illustrated floor has various attributes that render it useful in manufactured housing including those structures intended for use directly or eventually as residential housing. Floor **22** is shown partially constructed and in partial exploded configuration to facilitate illustration thereof.

[0021] The illustrated floor includes one or more longitudinal support members **24** extending in a first direction, one or more cross beams **26** extending between beams **24** and a plurality of SIPs **10** secured to cross beams **26**.

[0022] A plurality of beams **26** may extend substantially laterally and are spaced apart along the length of the floor. One or more longitudinal support members **24** are provided to secure the plurality of beams **26** in position relative to each other. Generally, longitudinal support members **24** are each secured to at least a pair of beams **26** to hold them in relative position to resist lateral loads and, for example, members **24** may be secured to beams **26** at their ends and at upper and lower positions thereof. Longitudinal support members **24** may be continuous along the length of the floor, as illustrated, or may include a plurality of members positioned along the length of the floor.

[0023] In some embodiments such as the one illustrated, longitudinal support members **24** may be provided to act between the remainder of the structure, including the remainder of the floor, the walls, roof, etc. and a supporting structure or structures, such as piles, a skid, a continuous or non-continuous foundation or a sub frame. In the illustrated embodiment, floor **22** is intended to be supported on a perimeter foundation of foundation walls or piles and, thus, longitudinal support members **24** are positioned along side edges of the floor.

[0024] Two cross beams **28** extend between beams **24** and form the end limits of the floor. Members **24** may also be connected to beams **28**, if desired.

[0025] Beams **24**, **26**, **28** provide some structural integrity for the floor and accommodate loads. Beams **24**, **26**, **28** may be formed of various materials such as lumber, engineered lumber, SIP beam, metal, structural polymers, etc., as desired, with consideration as to the forces to be accommodated thereby.

[0026] Beams **26** each include a lower portion **26***a* and an upper portion **26***b*, with the lower portion formed at least in part integral with the upper portion so that the two portions **26***a*, **26***b* act together. Beams **26** may for example be formed as extruded members, as a single one-piece structure or of a plurality of connected pieces such as a truss form. In the illustrated embodiment, for example, a single piece of material forms the inner core of lower portion **26***a* and upper portion **26***b*. Upper portions **26***b* each include at least one opening therethrough to provide access from one side to the other of the beam. The openings in the illustrated embodiment are constructed as notches **30** formed from a top beam surface **26***c*. Alternately, the openings may be formed as holes formed or cut through the material of upper portion **26***b* with material substantially continuously thereabout or as notches from end beam surfaces **26***d*, as desired. For example, openings may be formed by the members used to form a beam, if for example, the beams are formed of webbed or strut construction. Although in the illustrated embodiment, each beam includes two rectangular openings, with one on each end of the beam, such a configuration can vary in opening shape, number and position. Also, although the openings are shown consistent in size, shape and position such that they are aligned from beam to beam, the form, shape and size of the openings and their positions along their beam may vary from beam to beam, as desired.

[0027] A SIP **10** spans the open area created by the space between each adjacent pair of beams **26**, **28** and between longitudinal members **24**. Lower portion **26***a* of each beam **26** accepts connection of SIP **10**, the SIPs and the beams are formed such that each upper portion **26***b* protrudes above the SIP, when the SIP is secured to the beam. In the illustrated embodiment, bottom portion **26***c* has a protrusion **32** formed thereon including a shoulder **20** to fit into channels **18** formed on the SIP edges, such that the parts become keyed together. Protrusion **32**, in the illustrated embodiment, is formed elongate to extend along the length of each beam. Other configurations such as a plurality of spaced apart protrusions positioned along lower portion **26***a* may alternately be of use although possibly more complex to mass produce. Protrusion **32** may be formed by building up the materials of the beam along lower portion **26***a*, by removing portions of the beam along upper portion **26***b* or, as shown, connecting an elongate piece of material, such as a piece of lumber, along the length of the lower portion of beam **26**. In the illustrated embodiment, SIPs **10** are keyed to beams **26**, **28** to form a major portion of the building component.

[0028] Members **24** and beams **28** may also be formed with a lower portion **24***a*, **28***a*, respectively, and an upper portion **24***b*, **28***b*, respectively. The lower portion and the upper portion of each beam may be formed integral in the beams to avoid differential performance (i.e. against sag, and flexing stresses, etc.) of the two portions, as would be the case where the two parts were connected in close contact but formed separately. Lower portions **24***a*, **28***a* accommodate adjacent positioning or provide connection to SIPs **10**. In one embodiment, lower portions **28***a* of beams **28** may each include a

protrusion therealong to provide for a jointed connection to a grooved edge **18** of the SIP attached thereto.

[0029] Upper portions **24***b*, **28***b* of the beams may also protrude above the upper surface of the panels **10** to which they are attached and provide top surfaces **24***c*, **28***c* that extend substantially in a plane with top surfaces **26***c* of beams **26**.

[0030] If desired, SIPs **10** may each include an upper skin **12** and a lower skin **14** that both extend beyond the SIP's foam core **16** so that channels **18** are defined by upper and lower extensions **12***a*, **14***a*. In such an embodiment, the floor may be manufactured by keying and securing the beam protrusions **32** into the channels with a skin extension extending out along both the upper and lower sides of the protrusion. Lower skin extension **14***a* may be longer than extension **12***a* and for example generally ½ the thickness of the beam's lower portion **26***a* such that the skin extensions on either side of a beam come substantially together below a beam **26** to span substantially across beneath lower portion **26***a*. Alternately or in addition, each SIP may be secured through both skin extensions **12***a*, **14***a* to beams. Securing may be by fasteners, adhesives, deformation, etc. Keying the beams into channels formed by upper and lower skins **12***a*, **14***a* enhance floor strength over a keying process relying on engagement provided by a channel/shoulder including only one skin extension.

[0031] If desired, skin extensions may also be formed to extend out above and below any protrusions on beams **24** and **28**.

[0032] Floor **22** further includes a top sheet material **34** connected directly or indirectly to at least some top surfaces **24***c*, **26***c*, **28***c* of the beams and members. Floor finishing materials such as sub flooring, carpet, rolled flooring, tiles, hardwood, etc may be laid on top of the top sheet material **34**. Because the top surfaces of the beams are spaced above the SIPs, a cavity **36** may be formed between the upper surface of SIPs **10** and the underside of top sheet material **34**. Cavity **36** may be in communication through the beams by openings **30**. Cavity **36** and openings **30** provide a chaseway **38** for running services, such as water lines, forced air ducts for heating and/or cooling, electrical, etc. Since SIPs **10** may provide an insulative effect and possibly also a vapor barrier effect, cavity **36** and the services contained therein, such as water lines, may be protected against the elements and form part of the controlled interior building envelope. In particular, SIPs **10** and their connection to beams may be selected to provide the full insulation and vapor barrier for the floor such that no further insulation and vapor barrier materials need be installed in floor **22**. Sealants such as foam or other liquid or film materials may be applied to seal the interfaces between panels **10**, members **24** and beams **26**, **28**.

[0033] A floor according to the present description may offer performance characteristics that may offer a benefit over some aspects of conventional, non-SIP construction, as shown in Table 1.

TABLE 1

Description	Conventional - no SIPS	Floor using present SIP construction
Span (Feet)	12	12
Depth (Inches)	18	12
Impenetrable Air/Vapour Barrier	NO	YES
R-Value	R28	R44
Weight (LBS)	Heavier	Lighter
Warm Cavity for Ductwork	NO	YES
Warm cavity for plumbing	NO	YES
Load Capacity(LBS/SF)	40	~100

[0034] If, desired, substantially the full load bearing performance of the floor may be accommodated in the lower portions of beams **24**, **26**, **28** and the SIPs therebetween so that treatment of the upper portions of the beams may not require much consideration with respect to the performance of the beams. For example, openings **30** may be formed without jeopardizing the load bearing performance of the floor beyond acceptable ratings (i.e. with consideration to building codes, etc). In one embodiment, for example, openings **40** may be formed through longitudinal support beams **24** for access to cavity **36** such as, for example, to provide a port for inlet or outlet of services.

[0035] If needed or desired, a fill frame **42** may be installed above a SIP between beams **26** and **24**, to provide further support for sheet material **34**. Fill frame **42** may be installed in various ways and configurations. In one embodiment, fill frame **42** is installed to leave service chaseways open between openings **30**, while providing acceptable support spacings for sheet materials **34**, as may be dictated by building codes.

[0036] Referring to FIG. **3**, a building structure **150** is shown according to one aspect of the invention including a floor structure **122**. Floor structure includes laterally extending beams **126** and longitudinal support members **124**.

[0037] Beams **126** each include a lower portion **126***a* and an upper portion **126***b*, with the lower portion integral with the upper portion so that the two portions **126***a*, **126***b* act together in response to longitudinal and lateral stresses. In the illustrated embodiment, for example shown in FIG. **3**C, beam **126** is formed of a single piece of engineered lumber (for example, laminated veneer lumber), which forms both the upper portion and the lower portion of the beam. Upper portions **126***b* each include at least one opening **130** therethrough to provide access from one side to the other of the beam. The openings in the illustrated embodiment are constructed as notches **131** extending down from a top beam surface **126***c*. The openings are aligned from beam to beam to permit the formation of a chaseway therethrough.

[0038] At least one SIP **110** spans the open area between each adjacent pair of beams **126**. In some embodiments, more than one SIP may be used to fill the area between beams. Such SIPs may be joined, keyed, secured and/or sealed together, as desired.

[0039] Lower portion **126***a* of each beam **126** accepts connection of a SIP **110** on each side thereof, the SIPs and the beams are formed such that each upper portion **126***b* protrudes above the SIP upper surface **110***a*, when the SIP is secured to the beam. In the illustrated embodiment, bottom portion **126***a* has a protrusion **132** formed thereon to fit into a channel **118** formed on the SIP edge, such that the parts become keyed together. Protrusion **132**, in the illustrated embodiment, is formed by connecting an elongate member along the length of the lower portion of beam **126**.

[0040] A plurality of longitudinal support members **124** are provided to secure the cross beams in relative position against

lateral shear loads. In the illustrated embodiment, the SIP edges include a channel **118** therealong formed between the upper sheet member **112** and the lower sheet member **114** of the SIPs and longitudinal members **124** such as a one or more strips of sheet material or pieces of lumber are positioned in the channels secured to at least a pair of adjacent cross beams **126**, as by use of adhesives or fasteners, in the channel. If desired, further longitudinal support members **124***a* may be installed along the upper portions **126***b* of the cross beams to further resist shear loads. Elongate members **124**, **124***a* can be installed to extend from one cross beam to an adjacent cross beam to thereby provide some rigidity across the beams and the SIP therebetween, for example SIP **110***a*. In another embodiment, the members **124**, **124***a* may be installed to extend substantially continuously from end to end of the floor.

[0041] The illustrated floor further includes a plurality of longitudinal support beams **151** extending in a first direction on which the plurality of cross beams **126** are supported. Longitudinal beams **151** are formed and positioned to support the floor against end to end bending and act between the floor and the supporting structure on which the structure is installed. In the illustrated embodiment beams **124**, **151** may steel I-beams formed as a skid, but may also be of lumber.

[0042] The end edges of the floor not connected to beams **126** may be protected by positioning sheathing or an edging therealong. Edging **152** protects the end edges and provides a base onto which further building materials may be secured.

[0043] Floor **122** further includes a top sheet material **134** connected directly, as shown, or indirectly to at least some top surfaces **126***c* of beams. Floor finishing materials such as sub flooring, carpet, rolled flooring, tiles, hardwood, etc may be laid on top of the top sheet material **134**. Because the top surfaces of the beams are spaced above the SIPs, a cavity **136** may be formed between the upper surface of SIPs **110** and the underside of top sheet material **134**. Cavity **136** may be in communication through the beams by openings **130**. Cavity **136** and openings **130** provide a space for running services, such as water lines, forced air ducts for heating and/or cooling, electrical, etc. Since SIPs **110** may provide an insulative effect and possibly also a vapor barrier effect, cavity **136** and the services contained therein, such as water lines, may be protected from the elements and form part of the controlled interior building envelope. In particular, SIPs **110** and their connection to beams may be selected to provide the full insulation and vapor barrier for the floor such that no further insulation and vapor barrier materials need be installed in floor **122**.

[0044] If, desired, substantially the full load bearing performance of the floor may be accommodated in members **124**, the lower portions of beams **126**, the SIPs therebetween and beams **151** so that treatment of the upper portions of the beams may not require much consideration with respect to the performance of the beams. For example, openings **130** may be formed without jeopardizing the load bearing performance of the floor beyond acceptable ratings, for example, with consideration to building codes, etc. In one embodiment, for example, openings **140** may be formed from cavity **136** such as, for example, to provide a port for inlet or outlet of services.

[0045] If needed or desired, a fill frame **142** may be installed above a SIP to create further surfaces **142***a* to support sheet material **134**.

[0046] A SIP floor **122** may be used in a building with stick frame or other types of construction used for the remaining components including walls and roof. Alternately, however, other planar building components such as the walls and/or the roof may be constructed using SIPs, if desired. The illustrated building structure **150**, for example, further includes a roof **154** and walls **156***a*, **156***b* constructed using SIPs **158**, **160**, respectively.

[0047] Roof **154** may include, for example, a plurality of beams **162** supported between walls **156***a*. Beams **162** each include a lower portion **162***a* and an upper portion **162***b*, with the lower portion integral with the upper portion so that the two portions **162***a*, **162***b* act together in response to longitudinal and lateral stresses.

[0048] At least one SIP **158** spans the open area between each adjacent pair of beams **162**. Lower portion **162***a* of each beam **162** accepts connection of SIP **158**, the SIPs and the beams are formed such that each upper portion **162***b* protrudes above the SIP upper surface, when the SIP is secured to the beam. In the illustrated embodiment, bottom portion **162***a* has a protrusion **164** formed thereon to fit into a groove **166** formed on the SIP edge, such that the parts become keyed together. Protrusion **164**, in the illustrated embodiment, is formed by connecting an elongate member, such as a piece of lumber, along the length of the lower portion of beam **162**.

[0049] The interconnected arrangement of SIPs **158** and beams **162** create an elongate roof structure. In the illustrated embodiment, upper portion **162***b* protrudes above the upper surfaces of SIPs **158** and a roof sheathing **167** may be connected to the upper surfaces **162***c* of beams **162** to create cavities **168** therebetween. Cavities **168** may accommodate some building services, but being external to SIPs, will not be insulated from the external building temperature. Of course, if desired, roof **154** could be inverted to position the SIPs **158** along the upper portion of the roof. However, it is noted that construction of the building may be facilitated using a roof structure, as shown, including SIPs **158** and beams **162** jointed together, with the SIPs connected along the lower portions of the beams. In particular, SIPs **158** may be selected that include drywall and/or other interior finishing materials as one sheet material layer **169**, the layer that will be downward facing in the final roof structure. Using such a SIP, the roof, once installed, may form directly the ceiling in the building structure. In addition, upper portions **162***b* of the beams may be formed to define structure on the roof, such as by forming a slope thereon. In the illustrated embodiment, for example, the height of upper portion **162***b* at one end (the right side in FIG. **3**B) is higher than the height at the other end and the beam height slopes gradually therebetween. As such, upper surfaces **162***c* have a slope that is duplicated in the roof sheathing.

[0050] Secondary framing including side members **170** and cross members **172** may be installed variously between beams **162**, in cavities **168**, along SIPs **158** to protect the edges of the SIPs and to provide further support for the roof and wall sheathing. Secondary framing members **170**, **172** may be formed to follow the roof sloping established by the shaping of upper portions **162***b*.

[0051] Walls **156***a*, **156***b* may also be constructed using SIPs **160**. In the illustrated embodiment, SIPs **160** are connected in end to end configuration along the walls with one SIP jointed and adhesively connected to its adjacent SIP or SIPs. SIPs **160** to be used in the walls may be selected to include drywall and/or other interior finishing materials as one sheet material layer **173**, the layer that will be inwardly facing in the final wall structure. Walls **156***a*, **156***b* may be formed with SIPs that include upper and lower extensions

174*a*, **174***b* on their outer sheet material layer **174**. Extensions **174***a*, **174***b* may be formed by extending outer sheet material layer **174** beyond inner sheet material layer **173** and beyond insulation core **116**. Extension **174***a* may be formed to extend over the thickness of the roof component and extension **174***b* may be formed to extend down over the floor component **122** so that a continuous wall base sheathing is provided, ready for exterior finishing materials.

[0052] The previous description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to those embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein, but is to be accorded the full scope as defined in the claims, wherein reference to an element in the singular, such as by use of the article "a" or "an" is not intended to mean "one and only one" unless specifically so stated, but rather "one or more". All structural and functional equivalents to the elements of the various embodiments described throughout the disclosure that are known or later come to be known to those of ordinary skill in the art are intended to be encompassed by the elements of the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed under the provisions of 35 USC 112, sixth paragraph, unless the element is expressly recited using the phrase "means for" or "step for".

I claim:

1. A planar building component comprising:

(a) cross beams extending substantially laterally in the planar building component, the cross beams each including an upper portion with a top surface and a lower portion formed at least in part integral with the upper portion;

(b) at least one longitudinal support member each supporting at least a pair of the cross beams in relative position in the building component;

(c) structurally insulated panels, each including a lower sheet material layer, an upper sheet material layer and foam insulation therebetween, the structurally insulated panels being connected to the lower portions of the cross beams to span a space between adjacent cross beams, the connection between the panels and the cross beams leaving the upper portion of the cross beams protruding above the panels; and

(d) component sheathing installed above the top surfaces of the cross beams creating a cavity between the panels and the component sheathing.

2. The planar building component of claim **1** wherein the longitudinal support member is positioned to act between the cross beams and a supporting structure below the planar building component.

3. The planar building component of claim **1** wherein the upper portions of a plurality of cross beams each include at least one opening therethrough to provide access from one side to the other of those cross beams.

4. The planar building component of claim **1** wherein the bottom portion of at least one cross beam includes a protrusion formed thereon to fit into a channel on an edge of a structurally insulated panel and the protrusion is keyed into the channel.

5. The planar building component of claim **1** wherein the lower portions of the cross beams each include a protrusion therealong to provide for a jointed connection to a grooved edge of the structurally insulated panels attached thereto.

6. The planar building component of claim **1** wherein at least one longitudinal support beam is secured on a perimeter of the planar building component.

7. The planar building component of claim **6** wherein the at least one longitudinal support beam includes an opening therethrough for access to the cavity.

8. The planar building component of claim **1** further comprising a fill frame installed above the structurally insulated panels and between cross beams to provide further support for component sheathing.

9. The planar building component of claim **1** further comprising edging materials applied on a perimeter of the planar building component.

10. A building structure comprising:

a horizontal building component including (a) cross beams extending substantially laterally in the planar building component, the cross beams each including an upper portion with a top surface and a lower portion formed at least in part integral with the upper portion; (b) at least one longitudinal support member each supporting at least a pair of the cross beams in relative position in the building component; (c) structurally insulated panels, each including a lower sheet material layer, an upper sheet material layer and foam insulation therebetween, the structurally insulated panels being connected to the lower portions of the cross beams to span a space between adjacent ones of the cross beams, the connection between the panels and the cross beams leaving the upper portion of the cross beams protruding above the panels; and (d) component sheathing installed above the top surfaces of the cross beams creating a cavity between the panels and the component sheathing; and

a wall member extending substantially vertically from the horizontal building component.

11. The building structure of claim **10** wherein the longitudinal support member is positioned to act between the cross beams and a supporting structure below the planar building component.

12. The building structure of claim **10** wherein the upper portions of a plurality of cross beams each include at least one opening therethrough to provide access from one side to the other of those cross beams.

13. The building structure of claim **10** wherein the bottom portion of at least one cross beam includes a protrusion formed thereon to fit into a channel on an edge of a structurally insulated panel and the protrusion is keyed into the channel.

14. The building structure of claim **10** wherein the lower portions of the cross beams each include a protrusion therealong to provide for a jointed connection to a grooved edge of the structurally insulated panels attached thereto.

15. The building structure of claim **10** wherein at least one longitudinal support beam is secured on a perimeter of the planar building component.

16. The building structure of claim **10** wherein the at least one longitudinal support beam includes an opening therethrough for access to the cavity.

17. The building structure of claim **10** further comprising a fill frame installed above the structurally insulated panels and between cross beams to provide further support for component sheathing.

18. The building structure of claim **10** further comprising edging materials applied on a perimeter of the planar building component.

19. The building structure of claim **10** wherein the wall member includes structurally insulated panels.

20. The building structure of claim **19** wherein at least some of the wall structurally insulated panels include an outer sheet material layer, an inner sheet material layer and an insulative layer between the sheet material layers.

21. The building structure of claim **20** wherein the inner sheet material layer includes interior finishing materials.

22. The building structure of claim **20** wherein the wall structurally insulated panels are mounted above the top surfaces of the cross beams and the outer sheet material layer extends down over a perimeter thickness of the horizontal planar member.

23. The building structure of claim **20** further comprising a roof including at least one structurally insulated panel.

24. The building structure of claim **23** wherein the roof includes a plurality of beams, at least two adjacent beams including a lower portion, an upper portion integral with the lower portion and at least one structurally insulated panel spanning an open area between the adjacent beams, the at least one structurally insulated panel including a skin formed of interior finishing materials positioned to be downward facing.

25. The building structure of claim **24** wherein the upper portion of the roof beams are cut to have a depth that decreases from one side to the other, such that a roof slope is formed.

26. A planar building component comprising:

(a) cross beams extending substantially laterally in the planar building component, the cross beams each including an upper portion with a top surface, a lower portion and a protrusion extending from at least one side of the lower portion;

(b) at least one longitudinal support member each supporting at least a pair of the cross beams in relative position in the building component;

(c) structurally insulated panels, each including a lower sheet material layer, an upper sheet material layer and foam insulation therebetween, the lower sheet material layer and the upper sheet material layer extending out beyond the foam insulation to form a channel along a panel edge, the structurally insulated panels being connected to the lower portions of the cross beams to span a space between adjacent cross beams, the connection having the protrusion inserted between and connected to the lower sheet material layer and the upper sheet material layer; and

(d) component sheathing installed above the top surfaces of the cross beams creating a cavity between the panels and the component sheathing.

27. The planar building component of claim **26** wherein the lower sheet material layer extends out beyond the foam insulation a distance greater than that distance extended by the upper sheet material layer such that the lower sheet material layers from the structurally insulated panels on either side of a cross beam abut below the cross beam.

28. The planar building component of claim **26** wherein the longitudinal support member is positioned to act between the cross beams and a supporting structure below the planar building component.

29. The planar building component of claim **26** wherein the upper portions of a plurality of cross beams each include at least one opening therethrough to provide access from one side to the other of those cross beams.

30. The planar building component of claim **26** wherein at least one longitudinal support beam is secured on a perimeter of the planar building component.

31. The planar building component of claim **30** wherein the at least one longitudinal support beam includes an opening therethrough for access to the cavity.

32. The planar building component of claim **26** further comprising a fill frame installed above the structurally insulated panels and between cross beams to provide support for component sheathing.

33. The planar building component of claim **26** further comprising edging materials applied on a perimeter of the planar building component.

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