An insulated structural panel is made from expanded polystyrene (EPS) panel and a plurality of interior and exterior structural members that are affixed to one another by screws is provided. When assembled, the interior and exterior structural members are flush with the EPS panel. A tongue at one end of the EPS panel engages a groove at another end of another EPS panel, therein permitting interlocking two or more EPS panels. The interior panel is C-shaped and is slid into a C-shaped passage in the EPS panel formed by hot-wire cutting the EPS panel. The exterior structural member is positioned within a channel formed opposite the passage. A top plate connects a plurality of interior structural members. A seam covering member is affixed to the one end of the EPS panel and is flush with the EPS panel. A thermal break is provided between the interior and exterior structural members.
START

PROVIDE THERMALLY INSULATIVE PANEL HAVING PRE-DEFINED PASSAGE AND CHANNEL

SLIDE FIRST STRUCTURAL MEMBER INTO PASSAGE

PLACE SECOND STRUCTURAL MEMBER IN CHANNEL

FASTEN FIRST STRUCTURAL MEMBER TO SECOND STRUCTURAL MEMBER

FINISH

FIG. 9
HIGH PERFORMANCE INSULATED STRUCTURAL PANEL

REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of U.S. Provisional Application Ser. No. 61/106,631 which was filed Oct. 20, 2008, entitled, HIGH PERFORMANCE GREEN BUILDING ROOF SYSTEM, the entirety of which is hereby incorporated by reference as if fully set forth herein.

FIELD OF THE INVENTION

[0002] The present invention relates generally to building construction systems and methods, and more specifically to a highly insulative modular structural panel.

BACKGROUND OF THE INVENTION

[0003] Efficient or “green” building is the practice of increasing the efficiency with which buildings use resources, such as energy, water, and materials, while reducing the building impacts on human health and the environment, through better design, siting, construction, operation and maintenance.

[0004] The related concepts of sustainable development and sustainability are integral to green building. Effective green building can lead to reduced operating costs by increasing productivity and using less energy and water, improved public and occupant health due to improved indoor air quality, and reduced environmental impacts by, for example, lessening storm water runoff and the “heat-island” effect. Practitioners of green building often seek to achieve not only ecological but aesthetic harmony between a structure and its surrounding natural and built environment, although the appearance and style of sustainable buildings is not necessarily distinguishable from their less-sustainable counterparts.

[0005] As energy and construction costs continue to rise, the importance of building systems and methods that are environmentally friendly and structurally sound continues to increase. Advancements in the construction industry have brought about new construction techniques that are more energy-efficient and environmentally-responsive. However, these improvements have lacked rigidity and tensile strength, and as such, have not been able to be built over two stories or more previously.

[0006] Therefore, an environmentally friendly building system and method are needed that encompasses energy efficiency, in both construction and in habitation, as well as being structurally as sound, if not more than, current building techniques.

SUMMARY OF THE INVENTION

[0007] The following presents a simplified summary in order to provide a basic understanding of one or more aspects of the invention. This summary is not an extensive overview of the invention, and is neither intended to identify key or critical elements of the invention, nor to delineate the scope thereof. Rather, the primary purpose of the summary is to present some concepts of the invention in a simplified form as a prelude to the more detailed description that is presented later.

[0008] The present invention is directed generally toward building construction systems and methods, and more specifically to a highly insulative modular structural panel. The insulative structural panel is configurable as both a wall structural panel and a roof structural panel, and is generally formed from a polymer foam such as expanded polystyrene (EPS) and a material such as steel, aluminum, or other sheet material. The wall structural panel is configured to connect to other wall structural panels, and provides a great degree of load-bearing capacity. The roof structural panels are configurable to be utilized in gable, hip, and flat roof designs, and have superior roof loading capabilities, as well as reduced dead load weights, as compared to conventional roofing structures. This insulative structural panels can be designed for any specific span lengths in both wall and roof applications. The insulative structural panels of the present invention are therefore configurable to be utilized in home, commercial, and industrial applications.

[0009] In accordance with one aspect of the invention, an insulative structural panel is provided, wherein the insulative structural panel comprises a thermally insulative panel having a first side (e.g., an interior side) and an opposing second side (e.g., an exterior side). The thermally insulative panel, for example, is comprised of a polymer-based foam, such as expanded polystyrene. A generally C-shaped passage in the insulative panel is associated with the first side of the insulative panel, wherein the passage extends from a first end to a second end of the thermally insulative panel. The passage, according to one exemplary aspect, is hot-water cut into the insulative panel, wherein the passage has a clearance width associated therewith. The insulative panel further comprises a channel associated with the second side and located generally opposite to the passage, wherein the channel generally extends from the first end to the second end of the thermally insulative panel.

[0010] A first structural member is provided, wherein the first structural member is comprised of a sheet of material generally formed in a C-shape and configured to generally mate with the passage formed in the insulative panel. The sheet of material, for example, has a thickness associated with the clearance width of the passage, wherein the first structural member is configured to slidingly engage the passage in the thermally insulative panel. The first structural member thus generally resides within the passage and generally extends from the first end to the second end of the thermally insulative panel. All but an edge portion of the first structural member is contiguously surrounded by the thermally insulative panel, wherein the edge portion of the first structural member that is not surrounded by the thermally insulative panel is substantially flush with a plane of the first side of the thermally insulative panel.

[0011] A second structural member is further provided, wherein the second structural member generally resides within the channel and extends from the first end to the second end of the thermally insulative panel. A separation between the first structural member and the second structural member defines a thermal break, wherein the insulative panel provides thermal insulation between the first structural member and the second structural member.

[0012] Furthermore, a plurality of fasteners are provided, wherein the plurality of fasteners generally fasten the first structural member to the second structural member, therein providing rigidity to the insulative structural panel. The plurality of fasteners, for example, comprise a plurality of truss screws, wherein holes defined in the first structural member and second structural member are engaged by the plurality of truss screws, therein fastening the first and second structural
members to one another and sandwiching a portion of the insulative panel therebetween.

[0013] In accordance with another exemplary aspect of the invention, the thermally insulative panel comprises a third side and a fourth side generally defined between the first side and second side. The third side, for example, comprises a tongue formed therein, and the fourth side comprises a groove formed therein, wherein the tongue of one insulated structural panel is configured to mate with the groove of another insulative structural panel, therein providing a mechanism for coupling two or more insulated structural panels to one another.

[0014] According to another aspect, the first end and second end of the insulative panel are generally planar and orthogonal to the first and second sides, wherein defining an insulative structural panel suitable for use as a vertical wall or flat roof. According to another aspect, one or more of the first end and second end of the insulative panel are not orthogonal to the first and second sides, wherein defining an insulative structural panel suitable for use as a hip or gable roof, wherein the non-orthogonal first or second end is configured to mate with another roof or wall insulative structural panel.

[0015] According to yet another inventive aspect, a plurality of passages and channels are provided in the thermally insulative panel, wherein a respective plurality of first structural members and second structural members are positioned within the plurality of respective passages and channels. A third structural member is then further provided, wherein the third structural member is fastened to the plurality of first structural members proximate to the first end of the thermally insulative panel. The third structural member, for example, generally extends from the third side to the fourth side of the thermally insulative panel, therein providing further rigidity to the insulated structural panel.

[0016] A fourth structural member may be further provided, wherein the fourth structural member, for example, is fastened to the plurality of first structural members proximate to the second end of the thermally insulative panel. The fourth structural member, for example, generally extends from the third side to the fourth side of the thermally insulative panel, therein again providing further rigidity to the insulated structural panel. The third and/or fourth structural members, for example, can comprise a fastening portion and a seam-covering portion, wherein the fastening portion is generally embedded into the thermally insulative panel and fastened to the plurality of first and/or second structural members, and wherein the seam-covering portion of the third and/or fourth structural members extends generally parallel to the first side of the thermally insulative panel from the first and/or second end thereof.

[0017] In accordance with yet another exemplary aspect, a fifth structural member is provided, wherein the fifth structural member generally extends along the third side or fourth side of the thermally insulative panel from the first end to the second end thereof. The fifth structural member, for example, further comprises a fastening portion and a seam-covering portion, wherein the fastening portion of the fifth structural member is generally embedded into the respective third side or fourth side of the thermally insulative panel, and wherein the seam-covering portion of the fifth structural member extends generally parallel to the first side of the thermally insulative panel from the respective third side or fourth side thereof.

[0018] In accordance with yet another exemplary aspect of the invention, a method of forming an insulated structural panel is provided, wherein the first structural member is slid into the passage in the insulative panel from the first end of the thermally insulative panel until the first structural member generally extends from the first end to the second end of the thermally insulative panel, and wherein all but the edge portion of the first structural member is contiguous surrounded by the thermally insulative panel. The second structural member is placed into the channel of the insulative panel, wherein the second structural member generally extends from the first end to the second end of the thermally insulative panel, and is separated from the first structural member by a thermal break portion of the thermally insulative panel. Further, according to another exemplary aspect, the first structural member is fastened to the second structural member, therein providing rigidity to the insulated structural panel. For example, a truss screw is driven through the first structural member and at least a portion of the thermally insulative panel and second structural member, therein fastening the first and second structural members together, thus providing further structural rigidity to the insulated structural panel.

[0019] Thus, to the accomplishment of the foregoing and related ends, the invention comprises the features hereinafter fully described and particularly pointed out in the claims. The following description and the annexed drawings set forth in detail certain illustrative embodiments of the invention. These embodiments are indicative, however, of a few of the various ways in which the principles of the invention may be employed. Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. 1 is an isometric view of an insulated structural panel constructed according one exemplary aspect of the invention.

[0021] FIG. 2 is an exploded isometric view of an insulated structural panel constructed according another exemplary aspect of the invention.

[0022] FIG. 3 illustrates an end view of an exemplary insulated structural panel according to yet another aspect of the invention.

[0023] FIG. 4 illustrates an end view of another exemplary insulated structural panel according to another alternative aspect of the invention.

[0024] FIG. 5 is a side view of an exemplary insulative panel comprising a third structural member according to yet another exemplary aspect of the invention.

[0025] FIG. 6 is a side view of an exemplary insulative panel comprising a fourth structural member according to another exemplary aspect of the invention.

[0026] FIG. 7 is a side view of an exemplary insulative panel comprising a structural member for covering a seam according to still another exemplary aspect of the invention.

[0027] FIG. 8 is an isometric view of an exemplary insulative panel in a roof panel configuration in accordance with still another aspect of the invention.
FIG. 9 is a flow diagram illustrating a method of fabricating an insulated structural panel in accordance with an aspect of the present invention.

**DETAILED DESCRIPTION OF THE INVENTION**

The present invention is directed generally toward a modular construction system, and more particularly, to an insulated structural panel and a method for forming an insulated structural panel. Accordingly, the present invention will now be described with reference to the drawings, wherein like reference numerals may be used to refer to like elements throughout. It should be understood that the description of these aspects are merely illustrative and that they should not be interpreted in a limiting sense. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be evident to one skilled in the art, however, that the present invention may be practiced without these specific details.

The present invention provides a green, environmentally friendly construction system and method that allows builders to construct structures with a reduced construction time. Walls and roof can be built at a prefabrication manufacturing facility and transported to the building site, wherein providing a simplified and quality-controlled installation. By utilizing the inventive aspects of the present invention, a building can be framed significantly faster than with traditional construction and structures in almost any weather condition, while also improving thermal insulative properties of walls and roofs built utilizing the insulated structural panels of the present invention.

Referring now to the Figures, FIG. 1 illustrates an isometric view of an assembled insulated structural panel 100 in accordance with one exemplary aspect of the present invention. The insulated structural panel 100 comprises a thermally insulative panel 102 having a first side 104 and an opposing second side 106. The thermally insulative panel 102, for example, is comprised of a foamed polymer, such as expanded polystyrene (EPS). It should be noted that the thermally insulative panel 102 of the present invention is formed from a contiguous block of EPS, wherein the block of EPS is cut and shaped to define various features therein, as will be discussed further infra.

In order to gain a better understanding of the invention, the insulated structural panel 100 is further illustrated in a blown-up form in FIG. 2. According to the exemplary aspect, a passage 108 is associated with the first side 104 of the thermally insulative panel 102, wherein the passage generally extends from a first end 110 to a second end 112 (e.g., illustrated in FIG. 1) of the thermally insulative panel. The passage 108 illustrated in FIG. 2, for example, is generally C-shaped, having a clearance width 114 associated therewith. A channel 116 is associated with the second side 106 of the thermally insulative panel 102, wherein the channel also generally extends from the first end 110 to the second end 112 of the thermally insulative panel. According to the present example, the channel 116 is located generally opposite to the passage 108. The passage 108, for example, is hot-wire cut into the thermally insulative panel 102 (e.g., a block of EPS), and the channel 116 can be hot-wire cut or otherwise formed. Accordingly, it is noted that the clearance width 114 of the passage 108 may be associated with a thickness of a hot wire (not shown) utilized to cut or form the passage.

In accordance with the invention, a first structural member 118 is provided, wherein the first structural member is comprised of a sheet of material 120 generally formed in a C-shape, and generally matching a profile 122 of the passage 108. The sheet of material 120, for example, is comprised of sheet steel (e.g., galvanized sheet steel) or aluminum. Alternatively, the sheet of material may comprise another metallic or non-metallic material capable of providing rigidity to the insulated structural panel 100. The sheet of material 120 has a thickness 124 associated with the clearance width 114 of the passage 108, wherein the first structural member 118 is configured to slidingly engage the passage 108 in the thermally insulative panel 102. The clearance width 114, for example, is less than or approximately equal to the thickness 124 of the sheet of material 120, wherein a friction fit between the first structural member 118 and the thermally insulative panel 102 is provided. Alternatively, the clearance width 114 is slightly greater than the thickness 124 of the sheet of material 120, wherein the sliding engagement between the first structural member 118 and the thermally insulative panel 102 is eased.

Accordingly, when assembled, the first structural member 118 generally resides within the passage 108, as illustrated, for example, in FIG. 1, and generally extends from the first end 110 to the second end 112 of the thermally insulative panel 102, wherein all but an edge portion 126 of the first structural member is contiguously surrounded by the thermally insulative panel. As such, structural integrity of the thermally insulative panel 102 is significantly maintained, wherein providing further structural rigidity to the resulting insulated structural panel 100.

Accordingly, the edge portion 126 of the first structural member 118 that is not surrounded by the thermally insulative panel 102 is substantially flush with a plane 128 of the first side 104 of the thermally insulative panel, as further illustrated in FIGS. 3 and 4. It should be noted that the edge portion 126 of the first structural member 118 can be proud of the plane 128 of the first side 104 of the thermally insulative panel 102 by the thickness 124 of the first structural member illustrated in FIG. 2. Alternatively, the passage 108 can be cut such that the edge portion 126 is cut into the thermally insulative panel 102, therein making the edge portion of the first structural member flush with or even recessed from the plane 128 of the first side 104 of the thermally insulative panel. It should also be noted that the first structural member 118 may not necessarily extend all the way from the first end 110 to the second end 112 of the thermally insulative panel 102, and such a configuration is also contemplated as falling within the scope of the present invention.

According to another exemplary aspect, second structural member 130 is further provided, as illustrated again in FIGS. 1 and 2, wherein the second structural member generally resides within the channel 116 and also generally extends from the first end 110 to the second end 112 of the thermally insulative panel 102. The second structural member 130, for example, comprises a square tube 132 (e.g., as illustrated in FIG. 2) formed from a material similar to that of the first structural member 118. Accordingly, it is important to note that a separation 134 is provided between the first structural member 118 and second structural member 130, therein defining a thermal break or thermal de-coupling of the first and second structural members (e.g., provided by the thermally insulative panel 102). Such a thermal break is advantageous over previous designs, as the present invention generally does not have a highly-thermally conductive material
continuously penetrating the thermally insulative panel 102 from the first side 104 (e.g., an interior or thermally conditioned side) to the second side 106 (an exterior or non-conditioned environment side).

[0037] In order to provide further structural rigidity, in accordance with another aspect of the invention, a plurality of fasteners 136 are provided, wherein the plurality of fasteners fasten the first structural member 118 to the second structural member 130, therein sandwiching a portion 138 of the thermally insulative panel 102 therebetween. It is noted that the plurality of fasteners 136 do not provide a substantial thermal bridging between the first side 104 and second side 106 of the thermally insulative panel 102, therein maintaining the thermal break in the portion 138 of the thermally insulative panel 102. The plurality of fasteners 136, for example, comprise a plurality of truss screws 140. The plurality of truss screws 140, for example, comprise self-tapping heads, wherein holes 142 are defined in the first structural member 118 and second structural member 130 by the self-tapping heads of the plurality of truss screws. Alternatively, the holes 142 can be drilled in a separate operation.

[0038] As illustrated in FIGS. 3 and 4, the plurality of fasteners 136 can be configured to fasten the first structural member 118 to the second structural member 130 from the first side 104, as illustrated in FIG. 3, or from the second side 106, as illustrated in FIG. 4. In either arrangement, however, it is noted that the plurality of fasteners 136 limit a total conduction of heat from the first side 104 to the second side 106, or vice-versa. The plurality of fasteners 136, in one example, are comprised of steel and/or aluminum. Alternatively, the plurality of fasteners 136 are comprised of a non-thermally conducting material, such as a polymeric or composite material.

[0039] In accordance with another exemplary aspect of the invention, the thermally insulative panel 102 of FIGS. 1 and 2, for example, comprises a third side 144 and a fourth side 146 defined between the first side 104 and second side 106. The third side 144 and fourth side 146, for example, comprise a respective tongue 148 and groove 150, wherein providing a mechanism for coupling of two or more insulated structural panels 100 to one another, and providing a tight seal.

[0040] In accordance with still another inventive aspect, the thermally insulative panel 102 comprises a plurality of passages 108 and channels 116, wherein a respective plurality of first structural members 118 and second structural members 130 are positioned within the plurality of respective passages and channels. Accordingly, a third structural member 152 may be provided, as illustrated in FIG. 5, wherein the third structural member, for example, is fastened to the plurality of first structural members 118 of FIG. 1 proximate to the first end 110 of the thermally insulative panel 102. In such a configuration, the third structural member 152 of FIG. 5 generally extends from the third side 144 to the fourth side 146 of the thermally insulative panel 102 of FIGS. 1 and 2, therein providing further rigidity to the insulated structural panel. A fourth structural member 154 illustrated in FIG. 5, for example, may also or alternatively be provided, wherein the fourth structural member is fastened to the plurality of first structural members 118 proximate to the second end 112 of the thermally insulative panel 102, and wherein the fourth structural member generally extends from the third side 144 to the fourth side 146 of FIGS. 1 and 2 of the thermally insulative panel. Accordingly, a great degree of structural rigidity can be provided to the insulated structural panel 102.

[0041] FIG. 6 illustrates a similar arrangement, wherein the third structural member 152 and/or fourth structural member 154 are fastened or otherwise coupled to the second structural member 130 in a manner similar to that discussed above.

[0042] FIG. 7 illustrates another exemplary aspect, wherein the third structural member 152, for example, comprises a fastening portion 156 and a seam-covering portion 158, wherein the fastening portion of the third structural member is generally embedded into the first end 110 of the thermally insulative panel 102, and wherein the seam-covering portion of the third structural member extends generally parallel to the first side 104 of the thermally insulative panel from the first end 110 thereof. The fastening portion 156 of the third structural member 152, for example, may further be fastened to the plurality of first structural members 118. The third structural member 152, for example, comprises a J-channel (e.g., a channel having a generally J-shape) formed from a material similar to the first and second structural members 118 and 130.

[0043] In accordance with yet another exemplary aspect, a fifth structural member (not shown) may be provided, wherein the fifth structural member generally extends along one of the third side 144 and fourth side 146 of the thermally insulative panel 102 of FIGS. 1 and 2 from the first end 110 to the second end 112 thereof. Accordingly, the fifth structural member comprises a fastening portion and a seam-covering portion similar to that of the third structural member 152 described above, wherein the fastening portion of the fifth structural member is generally embedded into the third side 144 or fourth side 146 of the thermally insulative panel 102, wherein the seam-covering portion of the fifth structural member extends generally parallel to the first side 104 of the thermally insulative panel from the respective third side or fourth side thereof.

[0044] It is noted that the insulated structural panel 100 illustrated in FIGS. 1 and 2, for example, can be utilized as wall panels, wherein the first end 110 and second end 112 are generally planar and orthogonal to the first and second sides 104 and 106. In one alternative aspect, one or more of the first end 110 and second end 112 are not orthogonal to the first and second sides 104 and 106, wherein a roof panel 160 can be defined, and one example of such a roof panel is illustrated in FIG. 8.

[0045] FIG. 8, for example, illustrates a seat cut 162 in the first end 110 of the thermally insulative panel 102. A ridge cut (not shown) may also be formed in the second end 112 of the thermally insulative panel 102, wherein the ridge cut and seat cuts 162 are angled appropriately to match the slope and features of a gable roof (not shown). When affixed, the first structural member 118 and second structural members 130 of FIGS. 1 and 2, for example, will be substantially flush with the first and second sides 104 and 106 of the thermally insulative panel 102.

[0046] According to another exemplary aspect, a hip roof (not shown) may be formed from the insulated structural roof panel 160, wherein the roof panel is cut at an angle (e.g., illustrated by dotted line 164) from the third side 144 to the fourth side 146, wherein a length of the third side is less than a length of the fourth side. The roof panel 160 may also be utilized in a flat roof configuration, wherein the roof panel 160 takes much of the form of the insulative structural panel 100 of FIGS. 1 and 2. A steel membrane (not shown) may be further affixed to the first structural members 118, wherein the
steel membrane assists in providing a fire barrier to the interior side of the roof panel 160.

[0047] It is noted that the insulated structural panel 100 of FIGS. 1 and 2 and roof panel 160 of FIG. 8 can be factory cut in lengths to match any span requirement, and that additional cuts can be made for allowance of windows, doors, or other features, such as wire chases and the like. The air seal provided by the interlocking of the third and fourth sides 144 and 146 of the panels 100 and 160 is advantageous in keep unwanted cold, heat and moisture out of the resultant structure, therein ensuring a higher R-value. The inventors contemplate the embodiments of the invention providing insulations ratings of approximately R 30 for roofs with a 7” panel (e.g., measured from the first side 104 to the second side 106) and a R 50 for roofs with a 12” panel. An R-value is a term predominantly used in the building industry to describe the insulation properties of certain building insulation materials. Its use is limited to situations where thermal insulation is achieved by retarding the flow of heat through the material itself rather than reflecting radiant heat away. The higher the R-value, the greater the insulation, therefore, R-value is a measure of apparent thermal conductivity, and thus describes the rate that heat energy is transferred through a material or assembly. It is therefore desirable to have walls and roofs with a high R-value.

[0048] In accordance with the present invention, FIG. 9 illustrates an exemplary method 200 for forming an insulative structural panel. It should be noted that while exemplary methods are illustrated and described herein as a series of acts or events, it will be appreciated that the present invention is not limited by the illustrated ordering of such acts or events, as some acts may occur in different orders and/or concurrently with other acts apart from that shown and described herein, in accordance with the invention. In addition, not all illustrated steps may be required to implement a methodology in accordance with the present invention. Moreover, it will be appreciated that the methods may be implemented in association with the systems illustrated and described herein as well as in association with other systems not illustrated.

[0049] As illustrated in FIG. 9, the method 200 for forming an insulated structural panel begins with act 205, wherein a thermally insulative panel having a first side and a second side is provided. A passage associated with the first side of the thermally insulative panel extends from a first end to a second end of the thermally insulative panel, and wherein the passage is generally C-shaped having a clearance width associated therewith. A channel associated with the second side of the thermally insulative panel extends from the first end to the second end of the thermally insulative panel.

[0050] In accordance with one aspect, act 205 comprises providing a foam polymer panel in continuous block form, such as block of an EPS panel described above, wherein providing the passage and/or channel in the panel comprises cutting the passage into the foam polymer panel using a hot wire. Accordingly, the thermally insulative panel maintains its integrity and structural rigidity in the region of the passage. In act 210, a first structural member is slid into the passage from the first end of the thermally insulative panel until the first structural member generally extends from the first end to the second end of the thermally insulative panel. Accordingly, all but an edge portion of the first structural member is contiguous surrounded by the thermally insulative panel. Providing an initial block of EPS and forming the passage in act 205 prior to sliding the first structural member into the passage in act 210 eliminates the need for mixing and form-in-place molding of the EPS around the first structural member. Accordingly, costly facilities, molds, environmental permits, etc. typically required for such form-in-place molding are unnecessary in the practice of the present invention.

[0051] In act 215, a second structural member is placed into the channel, wherein the second structural member generally extends from the first end to the second end of the thermally insulative panel, and is separated from the first structural member by a thermal break portion of the thermally insulative panel.

[0052] Subsequently, in act 220, the first structural member is fastened to the second structural member, therein providing rigidity to the insulated structural panel. The fastening of the first structural member to the second structural member, for example, comprises driving a truss screw through the second structural member and at least a portion of the thermally insulative panel and first structural member. Alternatively, fastening the first structural member to the second structural member comprises driving a truss screw through the first structural member and at least a portion of the thermally insulative panel and second structural member.

[0053] In accordance with another aspect, the thermally insulative panel is provided with a plurality of passages and channels defined therein in act 205, wherein a plurality of first structural members are slid into the plurality of respective passages in act 210, and a plurality of second structural members are placed into the plurality of respective channels in act 215. Accordingly, a third structural member can be fastened to the plurality of first structural members proximate to the first end of the thermally insulative panel, wherein the third structural member generally extends from a third side to a fourth side of the thermally insulative panel, therein providing further rigidity to the insulated structural panel.

[0054] According to another example, a fourth structural member is coupled to the plurality of first structural members proximate to the second end of the thermally insulative panel, wherein the fourth structural member generally extends from the third side to the fourth side of the thermally insulative panel, therein providing further rigidity to the insulated structural panel.

[0055] It should be noted that the above listed embodiments are only a few of the possible combinations of thermally insulative structural EPS roofs and walls that have been built according to the many embodiments of the invention. For example, the internal structural members can be made flush to the roof or wall, and the exterior structural members can be made to protrude from the surface of thermally insulative panel. Such combinations provide flexibility in design for many building needs, such as the attachment of exterior or interior sheeting or finish materials.

[0056] Buildings constructed using the embodiments of the present invention will reduce the energy needed for heating and cooling, therein allowing smaller HVAC systems to be installed due to extremely high insulation ratings provided by the invention. Additionally, the use of steel structural members eliminates problems with warping, twisting, bowing, moisture content, rot and waste associated with conventional wood framing.

[0057] Although the invention has been shown and described with respect to a certain preferred embodiment or embodiments, it is obvious that equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of this specification and the
annexed drawings. In particular regard to the various functions performed by the above described components (assemblies, devices, circuits, etc.), the terms (including a reference to a “means”) used to describe such components are intended to correspond, unless otherwise indicated, to any component which performs the specified function of the described component (i.e., that is functionally equivalent), even though not structurally equivalent to the disclosed structure which performs the function in the herein illustrated exemplary embodiments of the invention. In addition, while a particular feature of the invention may have been disclosed with respect to only one of several embodiments, such feature may be combined with one or more other features of the other embodiments as may be desired and advantageous for any given or particular application.

What is claimed is:

1. An insulated structural panel, comprising:
   a thermally insulative panel having a first side and an opposing second side, wherein a passage associated with the first side extends from a first end to a second end of the thermally insulative panel, and wherein the passage is generally C-shaped having a clearance width associated therewith, and wherein a channel associated with the second side extends from the first end to the second end of the thermally insulative panel, wherein the channel is located generally opposite to the passage;
   a first structural member, wherein the first structural member is comprised of a sheet of material generally formed in a C-shape, wherein the sheet of material has a thickness associated with the clearance width of the passage, and wherein the first structural member is configured to slidingly engage the passage in the thermally insulative panel, wherein the first structural member generally resides within the passage and extends from the first end to the second end of the thermally insulative panel, wherein all but an edge portion of the first structural member is contiguously surrounded by the thermally insulative panel, and wherein the edge portion of the first structural member that is not surrounded by the thermally insulative panel is substantially flush with a plane of the first side of the thermally insulative panel;
   a second structural member, wherein the second structural member generally resides within the channel and extends from the first end to the second end of the thermally insulative panel, and wherein a separation between the first structural member and second structural member defines a thermal break; and
   a plurality of fasteners, wherein the plurality of fasteners fasten the first structural member to the second structural member, therein providing rigidity to the insulated structural panel.

2. The insulated structural panel of claim 1, wherein the thermally insulative panel is comprised of expanded polystyrene.

3. The insulated structural panel of claim 1, wherein the clearance width is less than or approximately equal to the thickness of the sheet of material.

4. The insulated structural panel of claim 1, wherein the first structural member and second structural member are comprised of one or more of steel and aluminum.

5. The insulated structural panel of claim 1, wherein the plurality of fasteners comprise a plurality of truss screws.

6. The insulated structural panel of claim 5, wherein the plurality of truss screws comprise self-tapping heads, wherein holes are defined in the first structural member and second structural member by the self-tapping heads of the plurality of truss screws.

7. The insulated structural panel of claim 1, wherein the plurality of fasteners are comprised of one or more of steel and aluminum.

8. The insulated structural panel of claim 1, wherein the thermally insulative panel comprises a third side and a fourth side defined between the first side and second side, wherein the third side and fourth side comprise a respective tongue and groove, therein providing a mechanism for coupling of two or more insulated structural panels to one another.

9. The insulated structural panel of claim 1, wherein the first end and second end are generally planar and orthogonal to the first and second sides.

10. The insulated structural panel of claim 1, wherein one or more of the first end and second end are not orthogonal to the first and second sides.

11. The insulated structural panel of claim 1, comprising a plurality of passages and channels in the thermally insulative panel, wherein a respective plurality of first structural members and second structural members are positioned within the plurality of respective passages and channels, wherein the insulated structural panel further comprises:
   a third structural member, wherein the third structural member is fastened to the plurality of first structural members proximate to the first side of the thermally insulative panel, and wherein the third structural member generally extends from a third side to a fourth side of the thermally insulative panel, therein providing further rigidity to the insulated structural panel.

12. The insulated structural panel of claim 11, further comprising:
   a fourth structural member, wherein the fourth structural member is fastened to the plurality of first structural members proximate to the second side of the thermally insulative panel, and wherein the fourth structural member generally extends from a third side to a fourth side of the thermally insulative panel, therein providing further rigidity to the insulated structural panel.

13. The insulated structural panel of claim 11, wherein the third structural member comprises a fastening portion and a seam-covering portion, wherein the fastening portion of the third structural member is generally embedded into the first end of the thermally insulative panel and fastened to the plurality of first structural members, and wherein the seam-covering portion of the third structural member extends generally parallel to the first side of the thermally insulative panel from the first end thereof.

14. The insulated structural panel of claim 1, further comprising:
   a fifth structural member, wherein the fifth structural member generally extends along the third side of the thermally insulative panel from the first end to the second end thereof, wherein the fifth structural member comprises a fastening portion and a seam-covering portion, wherein the fastening portion of the fifth structural member is generally embedded into the third side of the thermally insulative panel, and wherein the seam-covering portion of the fifth structural member extends generally parallel to the first side of the thermally insulative panel from the third side thereof.

15. A method of forming an insulated structural panel, the method comprising:
providing a thermally insulative panel having a first side and a second side, wherein a passage associated with the first side extends from a first end to a second end of the thermally insulative panel, and wherein the passage is generally C-shaped having a clearance width associated therewith, and wherein a channel associated with the second side extends from the first end to the second end of the thermally insulative panel;

sliding a first structural member into the passage from the first end of the thermally insulative panel until the first structural member generally extends from the first end to the second end of the thermally insulative panel, wherein all but an edge portion of the first structural member is contiguously surrounded by the thermally insulative panel;

placing a second structural member into the channel, wherein the second structural member generally extends from the first end to the second end of the thermally insulative panel and is separated from the first structural member by a thermal break portion of the thermally insulative panel; and

fastening the first structural member to the second structural member, therein providing rigidity to the insulated structural panel.

16. The method of claim 15, wherein providing the thermally insulative panel comprises providing a foam polymer panel and cutting the passage into the foam polymer panel using a hot wire.

17. The method of claim 15, wherein fastening the first structural member to the second structural member comprises driving a truss screw through the second structural member and at least a portion of the thermally insulative panel and first structural member.

18. The method of claim 15, wherein fastening the first structural member to the second structural member comprises driving a truss screw through the first structural member and at least a portion of the thermally insulative panel and second structural member.

19. The method of claim 15, wherein the thermally insulative panel comprises providing a plurality of passages and channels therein, the method further comprising:

- sliding a plurality of first structural members into the plurality of respective passages;
- placing a plurality of second structural members into the plurality of respective channels; and
- fastening a third structural member to the plurality of first structural members proximate to the first end of the thermally insulative panel, wherein the third structural member generally extends from a third side to a fourth side of the thermally insulative panel, therein providing further rigidity to the insulated structural panel.

20. The method of claim 19, further comprising:

- fastening a fourth structural member to the plurality of first structural members proximate to the second end of the thermally insulative panel, wherein the fourth structural member generally extends from the third side to the fourth side of the thermally insulative panel, therein providing further rigidity to the insulated structural panel.

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