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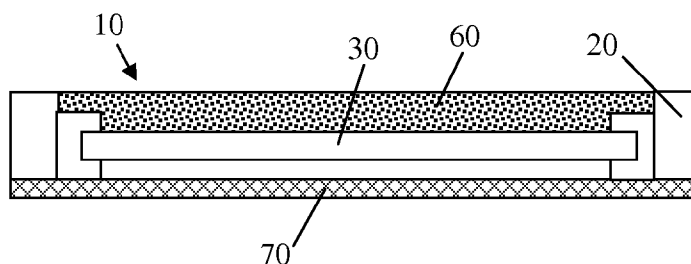
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(54) **Title:** SHEAR PANEL FOR USE WITH CONTINUOUS INSULATION

FIGURE 4



(57) **Abstract:** A shear panel (10) for use in light-framed building structures includes opposing vertical wall members (20) spaced apart from one another to define a frame cavity, a base above which the vertical wall members stand, at least one hold-down member attaching the vertical wall members to the base and a web member (30) attached to both vertical wall members and residing entirely within the depth of the frame cavity, the web member havin a planar surface that extends the entire width of the web member.



SHEAR PANEL FOR USE WITH CONTINUOUS INSULATION

BACKGROUND OF THE INVENTION

Field of the Invention

5 The present invention relates to a structural component for use in building light-framed building structures and the walls containing the structural component.

Description of Related Art

10 Light-framed building structures are subject to increasing regulations regarding structural integrity and thermal insulation properties. Structural integrity is necessary to prevent damage to a building during harsh weather conditions or other forces of nature. Thermal insulating properties are necessary to minimize energy usage in heating and/or cooling the interior of the building structure. While trying to increase both structural integrity and thermal insulating properties, builders are seeking to minimize cost both in
15 materials and time that goes into assembling a building structure.

 Narrow structural panels known as shear panels are one component of a light-framed building structure that is particularly challenging to build with structural integrity while achieving high thermal insulation and minimizing cost. Shear panels are narrow sections of a wall frame that typically have a height to width ratio of 4:1 or more (*that is*, that have a
20 height that is at least four times its width; having a high aspect ratio). Shear panels can be located in any portion of a wall frame. One common use for a shear panel is in constructing a portal frame (*for example*, a window or garage door opening). Portal frames contain shear panels adjacent to a portal through a wall and comprise a beam or header above the portal.

 Having a high aspect ratio makes shear panels susceptible to racking or other failure
25 when subjected to lateral loads such as those a strong wind can apply to a wall. Current shear panel designs address structural integrity concerns with high aspect ratio wall components but are not particularly conducive to incorporating continuous thermal insulation material to the outside of a wall frame containing the shear panel. A portal frame design incorporated into building codes (*for example*, 2009 IRC 602.10.3.3 and 2009 IBC
30 2308.9.3.2) as having adequate structural integrity requires installation of a wooden structural panel on the exterior of the shear panel of the portal frame. Such a design inhibits application of continuous insulation on the exterior of the wall frame by requiring a second

step of installing the insulation after installing the wooden structural panel and/or resulting in a section of the wall frame that is thicker and non-planar with portions of the wall frame that are not shear panels and do not require the wooden structural panel on the exterior of the frame. A similar challenge exists with wall structures that require application of a reinforcement sheet on one surface of a wall frame in order to achieve structural integrity. US 7,882,666 describes such structures, which require application of insulating material over and in addition to the reinforcement sheet in order to obtain a continuous thermal insulation layer in the wall.

Based on current designs, a struggle exists in designing shear panels that meet the high structural integrity requirements prescribed by codes while also meeting demanding thermal insulation requirements, particularly in the form of continuous exterior thermal insulation barriers. A shear panel design that provides high structural integrity and a continuous exterior insulation barrier without requiring application of both a wooden structural panel and subsequently a thermal insulation layer and that does not result in non-planar exterior wall surfaces between shear panel portions and non-shear panel portions would be desirable as relieving this struggle. Such a design would be particularly desirable if it was a simple design that required minimal labor and that used typical construction materials already available at a light-framed building site.

BRIEF SUMMARY OF THE INVENTION

The present invention offers a solution to the challenge of providing a shear panel design that provides high structural integrity and a continuous exterior insulation barrier without requiring application of both an exterior structural panel (or reinforcement sheet) and subsequently a thermal insulation layer and that does not result in non-planar exterior wall surfaces between shear panel portions and non-shear panel portions. Moreover, the present invention includes designs that require minimal labor to install and that use typical construction materials already available at a light-framed building site for use in other framing applications.

The present invention utilizes a planar web member interior to the shear panel that provides racking strength while allowing for application of a continuous exterior insulation over the shear panel, as well as interior to the shear panel.

In a first aspect, the present invention is a shear panel comprising: (a) opposing vertical wall members, each having height and width dimensions, spaced apart from one another to define a frame cavity, the frame cavity having a depth equal the width of the vertical wall members, a width equal to the distance between the opposing vertical wall members; (b) a base above which the vertical wall members stand and extend in their height dimension; (c) at least one hold-down member attaching the vertical wall members to the base, the hold-down member residing other than between a vertical wall member and the base or extending through the bottom of a vertical wall member into an accessible cavity in the vertical wall member; and (d) a web member attached to both vertical wall members and residing entirely within the depth of the frame cavity, the web member having a planar surface that extends the entire width of the web member.

In a second aspect, the present invention is a light-framed building structure comprising at least one shear panel of the first aspect.

The present shear panel of the present invention is useful for constructing walls of the present invention, which are useful in constructing building structure.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1-4 illustrate top cut-away views of shear panels of the present invention as viewed down from where a top plate would reside.

DETAILED DESCRIPTION OF THE INVENTION

“ASTM” refers to American Society for Testing and Materials and is used to designate a test method by number as published by ASTM. Test numbers refer to the most recent test published prior to the priority date of this document unless otherwise specified by a date using a hyphenated suffix after the test number.

“Multiple” means two or more. “And/or” means “and, or as an alternative”. All ranges include endpoints unless otherwise indicated.

“Length”, “width” and “thickness” are three mutually perpendicular dimensions of an object. Length is a dimension having a magnitude equivalent to the largest magnitude dimension of the length, width and thickness. Thickness has a magnitude equal to the smallest magnitude of the length, width and thickness. Width has a magnitude equal to the

length, thickness, both the length and thickness, or a magnitude somewhere between that of the length and thickness.

“Light-framed” building structure refers to a building structure comprising walls having studs spaced apart from one another. A light-framed building structure can comprise one or more than one shear panel.

A shear panel of the present invention is a section of a light-framed wall structure that comprises two vertical wall members spaced apart from one another, a base, at least one hold down member and at least one web member.

Vertical wall members in the shear panel of the present invention have length, width and thickness dimensions. The vertical wall members are typically in a position such that their length dimensions extend essentially parallel to one another. “Essentially parallel” means generally extending in the same direction but may deviate from precisely parallel by deviations generally accepted in construction industry. The vertical wall members are further typically in a position such that the width and length of each vertical wall member defines a major plane and the major plane of one vertical wall member faces the major plane of an adjacent vertical wall member. In such a typical position, the vertical wall members establish two sides of a frame cavity where the major planes of adjacent vertical wall members serve as opposing sides of the frame cavity and wherein the frame cavity has a depth equal to the width of the vertical wall members, a height equal to the length of the vertical wall members and a width equal to the spacing between vertical wall members. Typically, the frame cavity has a width of 30 inches or less, generally 24 inches or less and preferably 20 inches or less. It is common for the frame cavity to have a width of 19 inches or less, and even 18 inches or less, 16 inches or less, 14 inches or less, even 12 inches or less.

Vertical wall members can be any composition suitable for use as studs in light-frame construction. Suitable compositions include wood, laminated wood materials, composite structures that include wood materials, metal (typically light gauge metal), and composite materials that are free from wood.

Vertical wall members are desirably dimensional materials common in the light-frame construction industry. “Dimensional materials” have standard thicknesses and widths such as “2 by 3” (or “2x3”), 2x4, and 2x6 materials where the first number refers to the

thickness in inches plus 0.5 inch and the second number refers to the width in inches plus 0.5 inch. For instance, a 2x4 has a thickness of 1.5 inches and a width of 3.5 inches.

The vertical wall members extend in their length dimension above a base. The vertical wall members can directly contact the base and thereby stand directly on the base.

5 Desirably, the shear panel comprises a bottom member that attaches to both vertical wall members and extends along the base. The bottom member can reside entirely between the two vertical wall members or extend beneath the vertical wall members in the form of a bottom plate. When the shear panel includes a bottom plate the bottom plate extends between the vertical wall members and the base. If present, the bottom member typically
10 attaches both to the vertical members and the base by means of mechanical fasteners such as nails, screws or bolts.

The base is typically a foundation for a building structure incorporating the shear panel of the present invention. The foundation can be a foundation wall or slab. Typical bases include cement or concrete. The base can also be a sill plate that is itself attached to a
15 foundation directly or indirectly (for example, a second story sill plate can be indirectly attached to a foundation through the light frame structure of the first story). The base is typically in direct contact with either the vertical wall members or, if the shear panel includes a bottom plate, with the bottom plate. If desired, additional materials can reside between the base and either the vertical wall members or the bottom plate. For example, air
20 barrier materials such as compressible foam or caulk can reside between a base and either the vertical wall members or bottom plate.

Hold-down members connect and secure the vertical wall members to the base. When bottom members are present, it is desirable for the hold-down member to also connect and secure the bottom member to the base. It is desirable that the hold-down
25 members reside elsewhere than between the vertical wall members and the base in contrast to what is taught for example in United States (US) patent 6,668,508B2. Structures such as those in US patent 6,668,508B2 require that the hold-down member comprise a fixture that is precisely fit into specific notches or slots in the vertical wall member, an assembly that requires more time to make accurately and therefore costs more in both time and money to
30 construct than alternative designs. Moreover, it is desirable for the hold-down members to not extend through the bottom of a vertical wall member into an accessible cavity in the vertical wall member.

Suitable hold-down members for use in the present invention include hold-down components used in the art of light-framed construction including straps, plates, bolts, and combinations thereof. For example, a metal strap having one end embedded into a concrete slab base and the other end extending up from the concrete base can serve as a suitable hold-down by attaching the end of the strap extending up from the concrete base to a vertical wall member. It is desirable that the hold-down member have at least a 4200 pounds tensile load rating in order to optimally stabilize the shear panel. Examples of suitable hold-down members include USP STAD 14 and PHD4A hold downs as well as Simpson STHD14 and HDU8 hold-downs.

The shear panel of the present invention further comprises a web member extending between vertical wall members and residing entirely within the depth dimension of the frame cavity of the shear panel. The web member has a length, width and thickness wherein the width extends between vertical wall members. The web member desirably extends in a length dimension more than 50%, preferably at least 75%, more preferably at least 90% and most preferably the entirety of the height of the frame cavity. The web member has at least one planar surface that extends the entire width of the web member in contrast to, for example, corrugated structural elements as in US patent 2,101,090 and US published patent application 2005/0126105A1. Desirably, the planar surface of the web member spans at least 50%, preferably at least 75%, still more preferably at least 90%, and can span 100% of the width of the frame cavity. Determine the extent to which the planar surface of the web member spans the side of the frame cavity at any point along at least 50%, preferably 75% or more, still more preferably 90% or more of the length of the vertical wall members of the shear panel containing the web member.

It is desirable for the web member to occupy at least 75%, preferably 80% or more, still more preferably 90% or more, even more preferably 95% or more and conceivably 98% or more and even 100% or more of a planar area within the frame cavity of a shear panel of the present invention defined by the height and width of the frame cavity.

The web member attaches to both vertical wall members of the shear panel. The web member can attach directly to the vertical wall members. For example, the vertical wall members can include a notch along their length into which the web member fits and is attached. See, for example, Figure 1 showing a top view of shear panel **10** with vertical wall members **20** and web member **30** extending between vertical wall members **20** and inserted

into notch **25** in each vertical wall member. In such a configuration as in Figure 1, affix web member **30** to vertical wall members **20** with structural adhesive, mechanical fasteners, or both.

Similarly, a vertical wall member can comprise two vertical components that reside
5 on opposing sides of the web member so as to sandwich the vertical wall member between them and so as to include the web member directly into the vertical wall member. See, for example, Figure 2 showing a top view of shear panel **10** with vertical components **22** that sandwich web member **30** between them to form vertical wall members **20**.

The web member may alternatively attach indirectly to the vertical wall members. In
10 a particularly desirable embodiment of the present invention, the web member is part of an I-beam structural insert that comprises the web member and edge members that extend along the length of the web member, preferably extending the entire length of the web member, along opposing edges of the I-beam structural insert. The I-beam structural insert comprises a web member attached to opposing edge members. The dimensions of the web
15 member and edge members are such that a cross section of the I-beam structural insert perpendicular to its length is thicker at opposing ends than along the middle of the cross section's length. The edge members are attached to the vertical wall member typically with mechanical fasteners such as nails, screws, and bolts. It is further desirable to include a structural adhesive in combination with a mechanical fastener to attach the vertical wall
20 members to edge members to ensure a strong intimate adhesion. See, for example, Figure 3 showing a top view of shear panel **10** with vertical wall members **20** and web member **30**, which along with edge members **40** is part of I-beam structural insert **50**. Edge members **40** are then attached to vertical wall members **20** to form the shear panel.

Use of an I-beam structural insert is particularly desirable because I-beam
25 components suitable for use as I-beam structural inserts are typically present at a construction site for use as floor joists. A length of an I-beam component typically used for floor joists works well for quickly and readily fabricating a shear panel of the present invention by using a length of the I-beam component as an I-beam structural insert and affixing the I-beam structural insert between vertical wall members (for example, studs).
30 Examples of I-beam components suitable for use as I-beam structural inserts include wooden I-joist, particularly engineered wood I-joists, such as G-P WI40 Wood I Beam™ Joists from Georgia-Pacific (Wood I Beam is a trademark of Georgia-Pacific Wood

Products LLC) and LPI 32Plus I-Joists from Louisiana-Pacific (LPI is a trademark of Louisiana-Pacific Corporation).

When using an I-beam structural insert, it is desirable for the length of the I-beam structural insert to be essentially equal to the height of the frame cavity in which the I-beam structural insert resides. Optimal strength arises when the I-beam structural insert extends the full height of the frame cavity. Additionally, it is desirable for the distance between vertical wall members of the shear panel (that is, the width of the frame cavity in the shear panel) to be essentially equal to the distance between outside edges of the I-beam structural insert so the edge members of the I-beam structural insert contact the vertical wall members of the shear panel when inserted into the frame cavity of the shear panel. For optimal strength it is desirable to avoid having space between the I-beam and one or both vertical wall member. If the width of the wall cavity is greater than the distance between the outside edges of the I-beam structural insert it is desirable to position filler strips (*for example*, furring strips or some other type of solid material) between the I-beam structural insert and vertical wall member(s) in order to fill most and preferably all of any space between the I-beam structural insert and vertical wall member(s).

The web member can further attach to the base of the shear panel for additional strength. Alternatively, the shear panel may be free of attachments binding the web member to the base apart from the vertical wall members. That is, the shear panel can include or be free of direct attachment between the web member and the base that are apart from the vertical wall members. Regardless of whether the web member attaches to the base, the web member can contact the base or be free of direct contact with the base.

Web members are typically wood-based meaning at least 50 volume-percent (vol%) of the web member is wood relative to the total volume of the web member. The web member can be 75 vol% or more, 90 vol% or more, 95 vol% or more, even 100 vol% wood relative to the total web member volume. One desirable web member material is wood structural sheathing having a planar surface. Suitable wood structural sheathing includes oriented strand board (OSB) and plywood. Conceivably, the web member can be a structural cementitious panel although the shear panel of the present invention is preferably free of structural cementitious panels since they add significant weight and more challenging to handle than other web member options.

The web member can contain polymeric foam, but desirably comprises more than polymeric foam and can be entirely free of polymeric foam. Rigid polymeric foam board alone is not suitable as a web member in the present invention because it does not provide sufficient racking strength. Therefore, the web member is other than solely a rigid

5 polymeric foam board (*that is*, the web member is either free of rigid polymer foam board or comprises more than a rigid polymeric foam board but is not solely a rigid polymeric foam board).

The web member can be a solid sheet of material that spans the full width and height of the frame cavity (*that is*, the web material fills an entire plane in the width and height
10 dimensions (“height/width plane”) of the frame cavity). However, the web member can fill less than an entire height/width plane of the frame cavity. In manifestations of the present invention that utilize I-beam structural inserts to provide the web material it is already understood that the web member fills less than the entire height/width plane of the frame cavity because the edge members of the I-beam structural insert also occupy part of that
15 plane. It is also conceivable that part of the height/width plane of the frame cavity remains unoccupied. For example, the web member may not extend all the way to the base and thereby leave a space between the web member and base within the frame cavity.

Moreover, in order to facilitate installation of light fixtures in a shear wall of the present invention (*for example*, when the shear wall serves as a portal wall adjacent to a garage door
20 and a light fixture is desired on the portal wall) it is likely necessary have a hole in the web member to fit a housing for the electrical connections within the shear wall. It is desirable to keep holes in the web member minimal in size and further desirable to reinforce the web member around any such holes by framing the holes with thicker material attached to the web material.

25 One of the desirable features of the present shear panel is that it is easily constructed using components at a construction site. For example, a shear panel of the present invention can comprise dimensional lumber studs spaced apart a distance equal to the width of an I-joist used to construct a floor of the same structure. The I-joist can be cut to the height of the dimensional lumber studs, inserted between the studs and affixed to the studs. The
30 dimensional lumber studs can be affixed to a base on which the studs reside using hold-down members thereby creating a shear panel of the present invention with three common construction elements residing on a base and affixed to the base with hold-down members.

Another simple embodiment of the present shear comprises two pairs of 2x4 vertical elements sandwiching a sheet of OSB with the sheet of OSB extending across the space between vertical elements to create a shear panel similar to that illustrated in Figure 2.

In addition to being quick and easy to assemble, the present invention further provides for application of continuous external insulation without requiring two applications of exterior sheathing. Some shear panels require an external structural sheathing. In order to obtain continuous insulation over such a shear panel design a builder must apply the exterior structural sheathing and then apply over that insulation. The resulting shear panel has a thickness that exceeds the thickness of the rest of a wall containing the shear panel unless a panel equal in thickness to both the structural sheathing and insulation is applied over the entire wall. In contrast, the present shear wall design allows for application of insulation directly to the vertical wall members over the frame cavity without requiring external structural sheathing. As a result, application of continuous insulation over the wall is possible without having to account for uneven frame surfaces between shear panels and other portions of the wall. The present design allows construction of a wall containing a shear panel and continuous external insulation using a single thickness of exterior insulation and without having to apply exterior structural sheathing.

The shear panel of the present invention can further comprise an exterior sheathing attached to vertical members and spanning the cavity between vertical members. Exterior sheathing attaches to the “exterior” surface of the vertical members, which is the surface most proximate to the outside of a structure comprising the shear panel. The exterior sheathing material can be structural sheathing or non-structural sheathing. “Structural sheathing” provides sufficient resistance to resist racking loads (*that is*, is code approved to resist lateral loads, generally through passing ASTM E72 testing). Non-structural sheathing does not provide sufficient resistance to resist racking loads and is used for a purpose other than to achieve code approved strength in the wall. One advantage of the present invention is that structural sheathing is not necessary.

It is desirable for the shear panel of the present invention to comprise a thermally insulating exterior sheathing attached to vertical members and spanning the cavity between vertical members. The thermally insulating exterior sheathing can be structural sheathing such as structurally insulating sheathing (SIS) products including STYROFOAM SIS™ Brand Structural Insulating Sheathing (STYROFOAM SIS is a trademark of The Dow

Chemical Company). Alternatively, the thermally insulating exterior sheathing can be non-structural sheathing such as polymeric foam boards, panels or sheets. Polymeric foam non-structural sheathing includes extruded polystyrene (XPS) foam, expanded polystyrene (EPS) foam and isocyanurate foam. The polymeric foam non-structural sheathing can comprise
5 facers on two, one or no primary surface. A primary surface is a surface having the greatest planar surface area. Planar surface area is an area of a projection of a surface onto a plane so as to avoid taking into account surface texture.

A desirable embodiment of the present invention comprises a continuous spacing within the frame cavity that extends over the cavity width and preferably also the cavity
10 height in which thermally insulating material can reside without extending out from the frame cavity. For example, it is desirable to include a spray polyurethane foam insulation in the frame cavity on one side of the web member. A particularly desirable embodiment comprises both spray polyurethane foam insulation in the frame cavity on one side of the web member and a continuous thermal insulating barrier applied facing an opposing side of
15 the web member over the frame cavity and vertical wall members. See, for example, Figure 4 illustrating shear panel **10** from Figure 3 but further comprising spray polyurethane foam insulation **60** on one side of web member **30** and continuous thermal insulation **70** applied facing an opposing side of the web member over the frame cavity and vertical wall members **20**. The spray polyurethane foam insulation can completely cover a web member
20 or only cover a portion of the web member depending on the desire and need of the structural design.

The shear panels of the present invention are simple to construct, yet durable in resisting lateral loads. Shear panels of the present invention desirably resist lateral loads of 1500 pounds or more, preferably 2000 pounds or more, still more preferably 2200 pounds or
25 more, yet more preferably 2500 pounds or more, even more preferably 3000 pounds or more, and yet even more preferably 3500 pounds or more. Determine how much of a lateral load a shear panel can resist by testing according to ASTM E-564 "Static Load Test for Shear Resistance of Framed Walls for Buildings" test method.

The present invention further includes a light-framed building structure comprising
30 at least one shear panel of the present invention. The shear panel of the present invention can serve as a portal wall or as a structural reinforcing component anywhere in a light-framed building structure. Light-framed building structures of the present invention are

easily constructed and readily covered with continuous exterior thermal insulation without having to struggle with or account for thicker wall sections at shear panel locations.

The following examples serve to illustrate embodiments of the present invention.

5 Example 1: Shear Panel of Figure 2 Style

Use a sheet of oriented strand board (OSB) that is 7/16 inches thick, 22.5 inches wide and 81 inches long as a web member for a shear panel of the type illustrated in Figure 2. Aligned along both of the opposing 81 inch long edges of the OSB position two 81 inch long 2x4 lumber studs so as to sandwich the OSB between the studs along each 81 inch long edge and so as to align the 81 inch long edges of the studs and OSB with one another. The 3.5 inch wide surface of the studs should be adjacent to a surface of the OSB. Looking along the 81 inch long dimension of the lumber and OSB the orientation should resemble that in Figure 2. Attach each pair of 2x4 studs to the OSB portion they sandwich by driving 3-inch long framing nails (approximately 0.131 inch diameter) through the 2x4 studs and OSB every 6 inches along the 81 inch length along both sides of the structure (that is, along the 81 inch length of each 2x4 in a pairing). Place a 2x4 bottom plate along the 22.5 inch wide bottom of the resulting structure so that the 3.5 inch width of the 81 inch studs rests on and aligns with a 3.5 inch wide face of the 2x4 bottom plate. Nail the bottom plate to the 2x4 studs using two 0.162 inch diameter 3.5 inch long framing nails for each 2x4 stud. Each pair of 81 inch long studs and the portion of OSB sandwiched between them constitute a vertical wall member of the shear panel structure. The resulting assembly is a preliminary shear panel structure that once affixed to a base using hold-downs is an example of a shear panel of the present invention along with the base and hold-downs.

Incorporate four of the preliminary shear panel structures into a three dimensional light-framed wood structure in order to create and test four resulting shear panels at once. Position two preliminary shear panels in parallel-facing light-framed walls that are 30 feet long. Two parallel 12 foot wood light-framed walls run perpendicular to and attach to the 30 foot long walls so as to enclose a rectangular structure with outside dimensions of 12 feet by 30 feet. The walls of the structure all include a top plate and bottom plate such that a bottom plate extends all the way around the bottom of the three dimensional light-framed wood structure. All of the walls are 8 feet high from bottom plate to top plate with vertical studs positioned 16 inches on center. All wall framing is 2x4 lumber. The light-framed

wood structure is free of sheathing and drywall except for a sheet of 0.5-inch STYROFOAM® brand insulating foam board (STYROFOAM is a trademark of The Dow Chemical Company) attached with one-inch crown by 1.25 inch long 16 gauge staples at 12 inches on center around the perimeter of the panel over the outside of each of the shear panels and one 4 foot by 8 foot by 7/16-inch wood structural panel placed in the center of each 12 foot wall that serves to stabilize the structure during construction and does not significantly contribute to the lateral load resistance directed perpendicular to it.

Centered in each of the 30 foot walls is a 12 foot opening (portal). Position a preliminary shear panel on either side of the portal such that a vertical member defines a wall on either side of the portal. To the vertical wall member on the opposite side of each preliminary shear panel from the vertical wall member defining a wall of the portal attach a 93-inch king stud using 3-inch long 0.131-inch diameter nails every six inches on center. Position a header beam over each 12 foot opening with each end of the header beam resting on the top of the preliminary shear panels and extending from one king stud to the other king stud on either side of the portal to create portal frames. The header beam comprises two 2x12 lumber boards with a 7/16-inch wood structural panel filler piece in between the 2x12's with all three elements nailed together with 0.131-inch by 3 inch framing nails spaced 12 inches apart. Attach the header beam to the preliminary shear panels with a series of five 0.033 inch metal straps and nail the king stud of the preliminary shear panel to the end of the header beam with six 0.162-inch by 3-1/2 inch framing nails. Wrap an additional 0.033 inch strap around the king stud and nail it to both faces of the header beam to complete attachment of the header beam to the preliminary shear panel.

Construct the three-dimensional light-framed wood structure so that it sets upon and is entirely supported upon weigh cells positioned at a maximum of every four feet along the bottom plate and also under each shear panel with the bottom plate positioned resting directly on the weight cells. The weigh cells are mounted on steel pods that rest on a rigid steel channel that is securely attached to a concrete floor. Using L-shaped Simpson HDU8 hold downs attach the frame to the load cells within the preliminary shear panel. Drill a hole in the bottom plate directly over the weigh cell and position a threaded rod through the hole and into the weigh cell. Attach one face of the hold down to the threaded rod with a threaded nut thereby clamping the bottom plate to the weigh cell. Screw the other face of the hold down to the vertical wall member of the preliminary shear panel using 14 lag

screws. The preliminary shear panels in combination with the hold downs and weigh cells/steel rail/concrete base constitute shear panels of the present invention. Attach the remaining weigh cells to the frame by drilling a hole through bottom plate above each weigh cell, positioning a metal plate with a similar hole over the top of the bottom plate, inserting
5 a threaded rod through the hole in the metal plate and bottom plate into the weigh cell and then affix the weigh cell to the base plate and metal plate by screwing a nut onto the threaded rod.

Position seven light-framed wooden trusses spanning the 30 foot dimension of the structure at a 24 inch spacing. The trusses are sheathed with 7/16-inch wood structural
10 panel on the top of the top cords with 0.5-inch gypsum wall board on the bottom of the bottom cord. The trusses bear on and are attached to the top plate of the 12-foot walls with three 0.162 inch by 3.5 inch framing nails driven at an angle (toe nailed). The two outer trusses fully bear on the top plate of the 30 foot long walls and are attached with 0.162 inch by 3.5 inch framing nails toe nailed every three inches on center.

15 Test the lateral resistance of the three dimensional light-framed wood structure, particularly the shear panels in the structure, according to ASTM E-564 "Static Load Test for Shear Resistance of Framed Walls for Buildings." During the testing apply a transverse or perpendicular load to one of the 12 foot walls using two hydraulic cylinders placed at the top of each end of the 12 foot wall. A 10-inch steel structural beam runs horizontally
20 between the two hydraulic cylinders to distribute the load along the top of the 12 foot long wall. Measure applied force versus lateral deflection. The shear panel of Example 1 resists a total load of 3852 pounds of lateral load.

Examples 2 and 3: Shear Panel of Figure 3 Style

25 Assemble a shear panel having a design similar to that in Figure 3 using pre-manufacture I-joists, one having a width of 9.5 inches (for Example 2) and one having a width of 11-7/8 inches (for Example 3). Use Georgia Pacific WI-40 I-joists. Cut the I-joists to a length of 81 inches. Prepare Example 2 and Example 3 shear panels as follows:

30 Nail a 81-inch long 2x4 wooden stud to one flange (edge member) of the I-joist using 0.131 inch diameter three inch long nails so that the length of the stud is aligned with the length of the I-joist. To the opposing flange (edge member) nail in like manner a 93-inch long 2x4 king stud with one end aligned with an end (bottom) of the I-joist flange.

As in Example 1, attach a 2x4 bottom plate along the bottom of the I-joist aligned with and attached to the 2x4 studs using two 0.162 x 3.5 inch framing nails per stud. The resulting assembly is a preliminary shear panel structure.

Position four preliminary shear panels into a test structure in like manner as in
5 Example 1 except use the king stud of the preliminary shear panel as the king stud of the portals instead of having a separate king stud to which the preliminary shear panel is attached. Once incorporated into the test structure with the hold-downs in place each preliminary shear panel in combination with the hold downs and base (*that is*, the weigh
10 cell/steel rail/concrete floor combination) to which it is affixed constitute a shear panel of the present invention. Test the resulting shear panels in like manner as in Example 1.

The shear panel of Example 2 (9.5 inch I-joist) resists a total load of 1899 pounds lateral load and the shear panel of Example 3 (11-7/8 inch I-joist) resists a load of 2289 pounds lateral load.

CLAIMS:

1. A shear panel comprising:
 - a. opposing vertical wall members, each having height and width dimensions, spaced apart from one another to define a frame cavity, the frame cavity having a depth equal the width of the vertical wall members, a width equal to the distance between the opposing vertical wall members;
 - b. a base above which the vertical wall members stand and extend in their height dimension;
 - c. at least one hold-down member attaching the vertical wall members to the base, the hold-down member residing other than between a vertical wall member and the base or extending through the bottom of a vertical wall member into an accessible cavity in the vertical wall member; and
 - d. a web member attached to both vertical wall members and residing entirely within the depth of the frame cavity, the web member having a planar surface that extends the entire width of the web member.
2. The shear panel of Claim 1, further comprising a bottom member that runs along the base and that is attached to both vertical wall members and the base.
3. The shear panel of Claim 2, further characterized by the base member being a bottom plate that extends between the vertical wall members and the base and wherein the hold down members attach the bottom plate and the vertical wall members to the base.
4. The shear panel of Claim 1, further characterized by the web member's planar surface extending across at least 50% of the width of the frame cavity at any point along at least 50% of the length of one of the vertical wall members.
5. The shear panel of Claim 1, further characterized by the web member's planar surface extending across at least 75% of the width of the frame cavity at any point along at least 75% of the length of one of the vertical wall members.
6. The shear panel of Claim 1, further characterized by the web member comprising wood at a concentration of more than 50% by total web volume.
7. The shear panel of Claim 1, further characterized by being free of attachments binding the web member to the base apart from vertical wall members.

8. The shear panel of Claim 1, further characterized by the web being a wood structural sheathing material having a planar surface that extends the full width of frame cavity and wherein both vertical wall member comprises two vertical components that sandwich the structural sheathing within both vertical wall members such that the structural sheathing is affixed between the vertical components of the vertical wall members.

9. The shear panel of Claim 1, further characterized by the web member being part of an I-joist structure having opposing edge members that run along the length of the I-joists and that are attached to the vertical structural members.

10. The shear panel of Claim 1, further characterized by the width of the frame cavity being thirty inches or less.

11. The shear panel of Claim 1, further comprising exterior insulated sheathing covering the frame cavity and attached to the vertical framing members defining the frame cavity.

12. The shear panel of Claim 1, further comprising a spray polyurethane foam residing in the frame cavity.

13. A light-framed building structure comprising at least one shear panel of Claim 1.

FIGURE 1

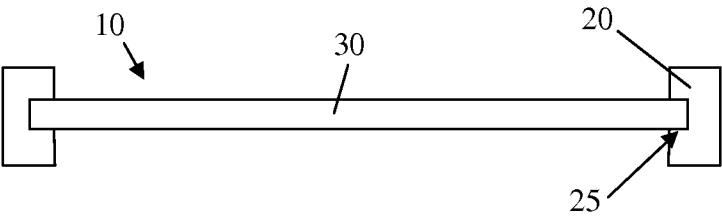


FIGURE 2

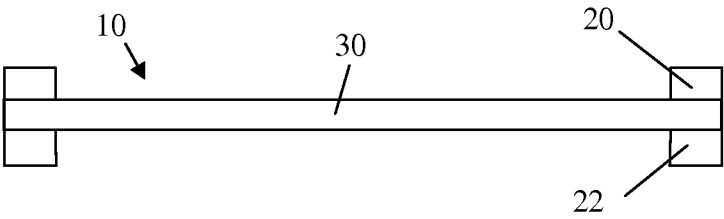


FIGURE 3

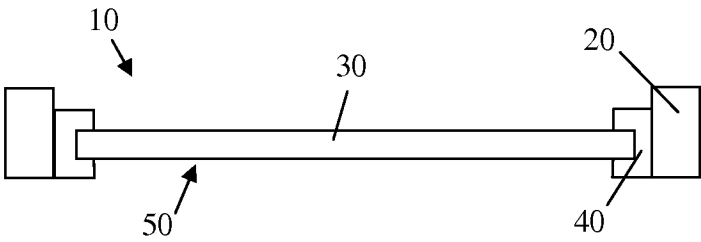
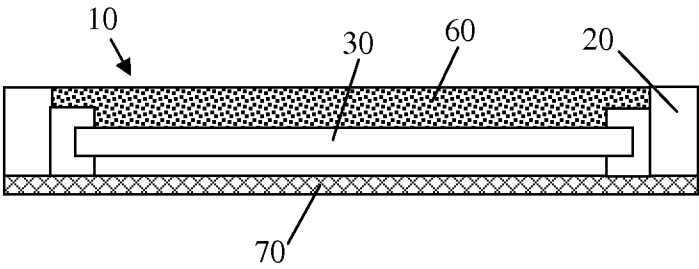


FIGURE 4



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/064055

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04B2/70
ADD. E04B1/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	column 7, lines 39-58; figures 5,6	9,11,12
X	US 6 018 917 A (LEEK WILLIAM F [US]) 1 February 2000 (2000-02-01)	1-3,7,10,13
X	US 2004/040236 A1 (ADAMS JAMES [US]) 4 March 2004 (2004-03-04)	1-8,10,13
Y	claim 1; figures 1,9	9
A	US 6 050 033 A (WRIGHTMAN RONALD A [CA]) 18 April 2000 (2000-04-18)	1
	figure 10	
	-/--	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/064055

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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International application No

PCT/US2011/064055

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