SYSTEM AND METHOD FOR CONSTRUCTING MODULAR WALL STRUCTURES

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ABSTRACT
A modular wall assembly structure capable of withstanding adverse external forces such as extreme weather conditions is disclosed. The modular structure is formed from a plurality of substantially parallel framing studs. A wallboard panel is affixed to the framing studs, and a support component is attached to the rear side of the framing studs to provide tensile strength to the wall structure. The modular wall assembly structure can be used to prepare solid wall panels, window panels, door panels, and corner panels. The wall assembly structure is sufficiently strong to withstand hurricane force winds without being destroyed. A method for constructing a modular wall exterior wall structure is also provided.
SYSTEM AND METHOD FOR CONSTRUCTING MODULAR WALL STRUCTURES

[0001] This application claims priority to U.S. provisional patent application Ser. No. 60/593,097, filed Dec. 9, 2004.

FIELD OF INVENTION

[0002] The present invention relates to building construction. In particular, the invention is directed to panel assemblies and methods used for the construction of load-bearing interior or exterior walls of buildings.

BACKGROUND OF INVENTION

[0003] Different types of wallboard panels exist for use by the building and construction industry. These wallboard panels may be used for interior or exterior wall construction. Many wallboard panel products are manufactured from gypsum, cement, chipboard, or other materials suitable for construction purposes. These panels are used in conjunction with other assemblies to form modular units that are used to both economize and reduce construction times of buildings and other types of construction projects.

[0004] Many such wallboard panels are manufactured in a manner that does not allow them to withstand adverse environmental conditions such as high speed winds, earthquakes, or hurricane conditions. The use of epoxy and sheet metal has allowed some wallboard panel manufacturers to construct wallboards that are reinforced in a manner that allows them to withstand increased in-plane or shear loads imposed on them, for example, by weather and/or other stress inducing means.

[0005] Despite reinforcing wallboard panels to exhibit higher in-plane load tolerances, the wallboard frame assembly system and method of construction must also be able to withstand adverse conditions that impose various loading and forces. For example, while the wallboard panel may be durable, its surrounding assembly must also assist in supporting the forces that are exhibited on the wallboard. Neglecting such an assembly may result in an overall failure of the structure to which the wallboard is attached. Hence, the durability and strength of the wallboard under these conditions would be rendered moot in light of the potential disaster at hand. Moreover, the framing structure and reinforced wallboard panel should be made of durable material and facilitate a modular easy-to-construct system for reducing construction complexity and time.

[0006] It is, therefore, an object of the present invention to provide a modular wallboard system capable of withstanding adverse weather conditions that may compromise the structural integrity of the modular system.

[0007] It is also an object of the present invention to provide a modular wallboard system that is able to withstand experimental test conditions in compliance with building code requirements, and in particular, Miami-Dade County (Florida) building codes.

[0008] It is yet another object of the present invention to provide a modular wallboard system that reduces construction times.

SUMMARY OF THE INVENTION

[0009] In an embodiment of the present invention, a modular exterior wall assembly structure capable of withstanding adverse external forces is provided. The wall modular assembly comprises a plurality of framing studs having a front side, a rear side, a top end, and a bottom end, wherein the framing studs are arranged in a substantially parallel orientation relative to one another.

[0010] The modular assembly structure also comprises at least one wallboard panel having a force resistant layer and a top layer that is adhered to the force resistant layer. The force resistant layer is affixed to the front side of the plurality of framing studs.

[0011] The modular assembly structure also comprises at least one support component attached to the rear side of the framing studs in a substantially orthogonal orientation relative to the framing studs. The support component is located at substantially the mid-point between the top end and bottom end of the framing studs and provides tensile support for the framing studs.

[0012] In another embodiment of the invention, a method is provided for constructing a modular exterior wall structure capable of withstanding extreme environmental conditions. The modular exterior wall structure comprises a wallboard panel having a force resistant layer, a support component, and a plurality of substantially parallel oriented framing studs.

[0013] The method comprises

(a) distributing the framing studs at a predetermined horizontal separation distance;

(b) attaching the wallboard panel to the framing studs;

(c) attaching a top and bottom track to each end of the framing studs to maintain the studs in a substantially parallel relationship; and

(d) attaching a support component at a substantially central location between the top and bottom ends of the framing studs.

[0014] Additional embodiments of the invention will be evident from the Figures and the detailed description below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 illustrates a reinforced wallboard panel having a force-resistant layer and a top layer that is adhered to the force-resistant layer for use in an embodiment of the present invention.

[0020] FIG. 2 illustrates a framing structure for use in an embodiment of the present invention and formed from a plurality of framing studs joined together by a support component, a top track, and a bottom track.

[0021] FIG. 3 is a view of a seal used in an embodiment of the invention to join two adjacent modular exterior wall assembly structures.

[0022] FIG. 4 is a front plan view of an embodiment of the present invention in which a modular exterior wall assembly structure is affixed to a monolithic slab.

[0023] FIG. 5 is a cross-sectional view of the modular exterior wall assembly structure shown in FIG. 4 taken along line 5-5.
FIG. 6 is a cross-sectional view of the modular exterior wall assembly structure shown in FIG. 4 taken along line 6-6.

FIG. 7 is a front plan view of a modular exterior wall assembly structure of an embodiment of the present invention having a window opening.

FIG. 8 is a cross-sectional view of the modular exterior wall assembly structure shown in FIG. 7 taken along line 8-8.

FIG. 9 is a cross-sectional view of the modular exterior wall assembly structure shown in FIG. 7 taken along line 9-9.

FIG. 10 is a front plan view of a modular exterior wall assembly structure having a door opening according to an embodiment of the present invention.

FIG. 11 is a cross-sectional view of the modular exterior wall assembly structure shown in FIG. 10 taken along line 11-11.

FIG. 12 is a cross-sectional view of the modular exterior wall assembly structure shown in FIG. 10 taken along line 12-12.

FIG. 13 is an isometric view of a window panel section of the modular exterior wall assembly structure according to an embodiment the present invention.

FIG. 14 is an isometric view of a door panel section of an embodiment of the modular exterior wall assembly structure according to an embodiment of the present invention.

DETAILED DESCRIPTION

An embodiment of the present invention will now be described with reference to the Figures. It is to be understood that the invention is not limited to the specific embodiments disclosed, as variations of the elements and mode of construction are possible within the scope of the attached claims.

FIG. 1 illustrates a reinforced wallboard panel which may be used in the construction of an embodiment the present invention. The wallboard panel may be comprised of a cementous material such as a cement board, and an adhered galvanized steel sheet for providing a load bearing panel capable of withstanding various external loads and forces that may occur, for example, due to adverse environmental conditions (e.g., hurricanes). The wallboard panel may optionally have pre-drilled holes to facilitate attachment of the panel to the framing studs. Once the steel sheet is adhered to the cement board, the wallboard panel is attached to components of a framing structure (shown in FIG. 2) via a plurality of screws. In one embodiment of the invention, the reinforced wall board is a Sure-Boards panel, distributed by Welmilt International Inc., Miami, Fla., and prepared in accordance with U.S. Pat. No. 5,768,841, the contents of which are incorporated herein by reference.

The screws provide a sufficient amount of coupling strength between the panel and framing structure to which the panel is attached. The coupling strength and structural stability of the framing components have been designed to be able to withstand various tests for ensuring compliance with the High Velocity Hurricane Zone of the Miami-Dade County (Florida) Building Code. These tests include, but are not limited to, air infiltration tests, static air pressure tests, large missile impact tests, fatigue loading tests, compression tests, racking tests, and tensile tests. In one embodiment of the invention, the wall assembly structure is free of wood-containing materials.

FIG. 2 illustrates a framing structure formed from a plurality of framing studs joined together by a support component, a top track, and a bottom track. The support component is located at about the midpoint of the parallel framing studs, and provides additional stability to the framing structure. The framing structure can be formed from any type of material which provide rigidity and stability to the wall assembly. For example, the framing structure can be formed from a metal such as steel, galvanized steel, or aluminum.

Each framing stud has openings which provide additional stability to the framing structure. The number and area of the openings, and the number and dimensions of the framing studs, will vary depending upon the particular embodiment of the invention. In one embodiment, the area of the openings is about 6 square inches, and the surface area for each framing stud is about 4.5 square feet. In one embodiment, each framing stud has two openings. The openings can be used to allow the passage of wires, pipes, or other items through the finished wall structure.

In one embodiment of the invention, one modular wall assembly structure comprises a framing structure formed from four parallel framing studs. In this embodiment, the framing studs are about 16 inches apart, and the length of the framing structure is about 4 feet.

As previously stated, a top track and a bottom track may be affixed to the framing structure to provide additional support and stability to the wall assembly structure. An angle iron can be affixed to the top track for supporting a roof truss.

The bottom track can comprise securing means for anchoring the wall assembly to a fixed location, such as a building foundation or a slab such as a monolithic slab. The securing means can take any kind of form. For example, the securing means can be anchor attachments which affix the bottom track to the fixed location. These anchor attachments can be located at any point of the bottom track, such as at opposite ends of the bottom track. The securing means can also comprise screw attachments which can be placed adjacent to the framing studs. In one embodiment, the screw attachments are placed adjacent to non-end framing studs, that is, studs which are not located at the ends of the wall assembly. The screw attachments can be placed on opposite sides of these non-end framing studs. Alternatively, the screw attachments can be placed at any position on the bottom of the wall assembly structure. Washers may be used to provide additional stability to the wall assembly structure to prevents its movement during severe weather conditions. An example of a washer is a 3 inch square washer which is 0.25 inches thick.

The modular wall assembly structure comprises a support component. This support component can be in the form of a bracing, such as a metal bracing. A single support component located at about the midpoint of the framing studs provides strength and rigidity to the modular wall.
assembly structure. Alternatively, a plurality of support components can be used, and they can be located at any convenient position, such as near the top and bottom ends of the wall assembly structure. The support component can be affixed to the framing studs using any convenient means, such as screws, bolts, or rivets. In one embodiment, three screws are used to join the support component to the framing studs.

[0042] The modular wall assembly structure can be used to build any wall section of a building. For example, the wall assembly structure can be a solid wall panel, a window panel, a panel adjacent to a window, a door panel, a panel adjacent to a door, or a corner panel. The particular orientation and placement of the components will depend upon the intended use of the wall assembly structure. Although the wall assembly structure is especially useful for load-bearing walls, such as interior or exterior load-bearing walls, the invention can also be used for interior walls.

[0043] Two or more modular assembly structures can be joined to form one or more walls of a building. The assembly structures can be joined using any convenient means, such as screws or bolts. Seals can be placed at the interface between adjacent assembly structures to prevent water or air seepage through the completed wall. FIG. 3 is a cross-sectional view of a seal used to join two adjacent modular exterior wall assembly structures according to an embodiment of the present invention.

[0044] As shown in FIGS. 4-12, an embodiment of the present invention can be used to prepare different wall panels, such as solid wall panels (FIGS. 4-6); window section panels (FIGS. 7-9); and door section panels (FIGS. 10-12). These different types of panels can be built using the same principles as discussed above, and advantageously have excellent resistance against extreme weather conditions. FIGS. 13 and 14 are isometric views of a window panel section and a door panel section, respectively, showing the construction of these structures in greater detail. In addition, all these panels satisfy the Miami-Dade County (Florida) High-Velocity Hurricane Zone building code, which has a stringent building code with regard to protection against hurricanes and other extreme weather conditions.

[0045] Numerous modifications and variations of embodiments of the present invention are possible in light of the above teachings, and therefore, within the scope of the appended claims, the invention may be practiced otherwise than as particularly described.

What is claimed is:

1. A modular exterior wall assembly structure capable of withstanding adverse external forces, the wall modular assembly comprising:
   - a plurality of framing studs having a front side, a rear side, a top end, and a bottom end, wherein the framing studs are arranged in a substantially parallel orientation relative to one another;
   - at least one wallboard panel comprising a force resistant layer and a top layer that is adhered to the force resistant layer, wherein the force resistant layer is affixed to the front side of the plurality of framing studs; and
   - at least one support component attaching to the rear side of the framing studs in a substantially orthogonal orientation relative to the framing studs, the support component located at substantially the mid-point between the top end and bottom end of the framing studs, the support component providing tensile support for the framing studs.

2. The modular wall assembly structure according to claim 1, wherein:
   - each of the framing studs has not more than two openings, each opening having an area no larger than about 6 square inches, wherein the openings provide an increased structural strength to the wall assembly structure; and
   - each framing stud has a surface area of about 4.5 square feet.

3. The modular wall assembly structure according to claim 1, wherein the maximum stud separation for the framing studs is about 16 inches, wherein the maximum stud separation provides an increased structural strength to the wall assembly structure.

4. The modular wall assembly structure according to claim 1, further comprising a top track affixed to the top end of the framing studs, the top track for maintaining the framing studs in a substantially parallel orientation.

5. The modular wall assembly structure according to claim 4, further comprising an angle iron attached to the top track, the angle iron for supporting a roof truss.

6. The modular wall assembly structure according to claim 1, further comprising a bottom track affixed to the bottom end of the framing studs, wherein the bottom track receives securing means for anchoring the wall assembly to a fixed location.

7. The modular wall assembly structure according to claim 6, wherein the securing means comprises:
   - at least two anchor attachments for securing opposite ends of the bottom track to the fixed location; and
   - at least two screw attachments for securing the bottom track to the fixed location, the two screw attachments attached adjacent to at least one of the framing studs.

8. The modular wall assembly structure according to claim 7, wherein the anchor attachments further comprise a washer for further stabilizing the bottom track to the fixed location.

9. The modular wall assembly structure according to claim 7, wherein the fixed location is a monolithic slab.

10. The modular wall assembly structure according to claim 8, wherein the washer is a square washer having a side length of at least 3 inches and a thickness of at least 0.25 inches.

11. The modular wall assembly structure according to claim 1, wherein the structure is free of wood-containing materials.

12. The modular wall assembly structure according to claim 1, wherein the framing studs are constructed from galvanized steel.

13. The modular wall assembly structure according to claim 1, wherein the top layer of the wallboard panel is constructed of a cementous material.

14. The modular wall assembly structure according to claim 1, wherein the force resistant layer is constructed from galvanized steel and provides an increased resistance to in-plane loads.
15. The modular wall assembly structure according to claim 1, wherein the support component, the top track, the bottom track, and the framing studs are constructed from steel.

16. The modular wall assembly structure according to claim 1, wherein the support component is affixed to each of the framing studs using a minimum of three screws.

17. The modular wall assembly structure according to claim 15, wherein the support component is a metal bracing strap having a width of about 6 inches.

18. The modular wall assembly structure according to claim 1, wherein the wall assembly structure is a solid wall panel, a window panel, a panel adjacent to a window, a door panel, a panel adjacent to a door, or a corner panel.

19. The modular wall assembly structure according to claim 1, wherein:

   the wall assembly structure comprises four framing studs, each separated by about 16 inches; and

   the wall assembly structure is about 4 feet long.

20. The modular wall assembly structure according to claim 1, wherein the wall assembly structure is capable of passing the High-Velocity Hurricane Building Zone code requirements of Miami-Dade County (Florida).

21. A method of constructing a modular exterior wall structure capable of withstanding extreme environmental conditions, the modular exterior wall structure comprising a wallboard panel having a force resistant layer, a support component, and a plurality of substantially parallel oriented framing studs, the method comprising the steps of:

   (a) distributing the framing studs at a predetermined horizontal separation distance;

   (b) attaching the wallboard panel to the framing studs;

   (c) attaching a top and bottom track to each end of the framing studs to maintain the framing studs in a substantially parallel relationship; and

   (d) attaching a support component at a substantially central location between the top and bottom end of the framing studs.

22. The method according to claim 21, further comprising the step of:

   (e) securing the bottom track to a foundation using a plurality of fixture components, the fixture components comprising:

   at least two wedge anchors driven into the foundation at each end of the bottom track; and

   at least two screw devices driven into the foundation adjacent to a framing stud which is not located at either end of the wall structure.

23. The method according to claim 22, further comprising the step of:

   (f) coupling an end stud located at one end of the wall assembly structure with a respective end stud associated with a second wall structure constructed in accordance with steps (a)-(d) to obtain an exterior wall formed from a plurality of modular wall assembly structures.

24. The method according to claim 23, further comprising the step of:

   (g) coupling an angle iron to the top track of the a modular exterior walls for maintaining straight line alignment between the plurality of modular exterior walls.

25. The method according to claim 24, wherein the foundation is a monolithic slab.

26. The method according to claim 21, wherein the framing studs are formed from steel.

27. A modular exterior wall assembly structure capable of passing the High-Velocity Hurricane Building Zone code requirements of Miami-Dade County (Florida).

28. The modular exterior wall assembly structure according to claim 27, wherein the wall assembly structure comprises a plurality of framing studs, a wallboard panel, and a support component.

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