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(54) SYSTEM AND METHOD FOR PROVIDING VIEWPORTS IN A CLOSED WALL FABRICATION PROCESS

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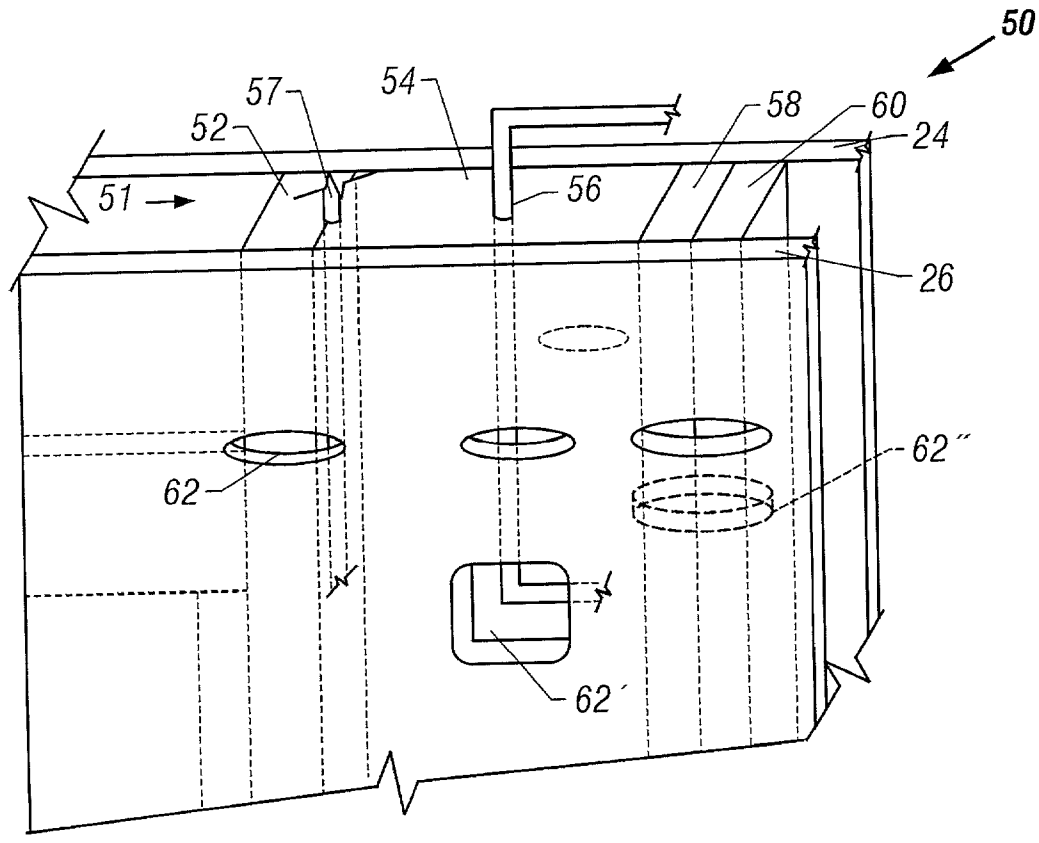
(57) **ABSTRACT**

The present invention provides one or more viewports formed at predetermined locations that allow inspections of an inside member of a closed wall system. The viewports can be disposed at predetermined locations that do not significantly impair the structural characteristics of the outward layers or inside members. In at least one embodiment, the viewports are formed in one or more outward layers during fabrication of a closed wall system. Generally, the closed wall system can be mass-produced in a manufacturing facility, although the closed wall system may be assembled at the job site.



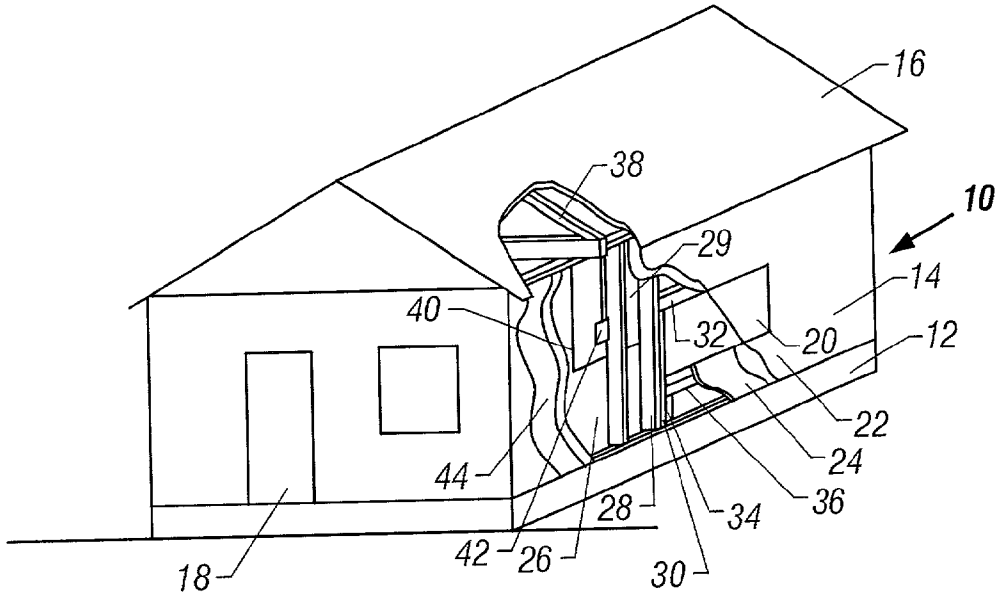

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FIG. 1

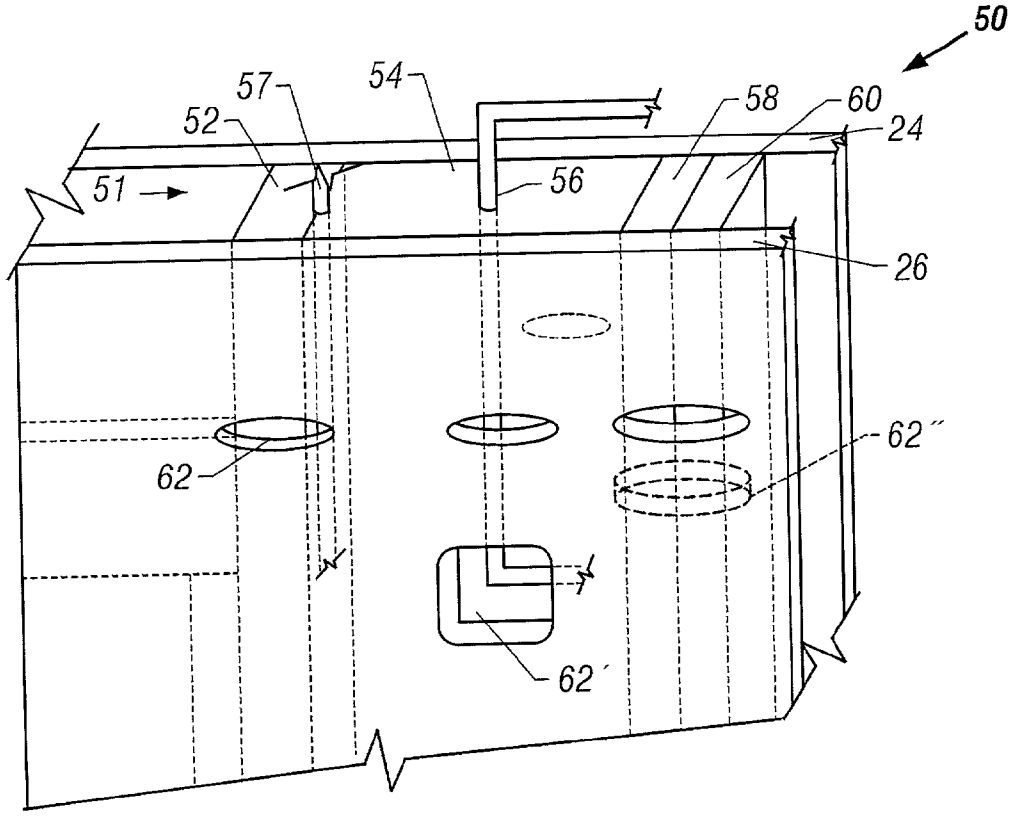
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FIG. 2

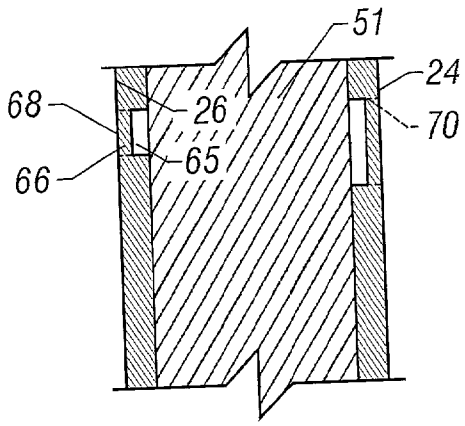

FIG. 3

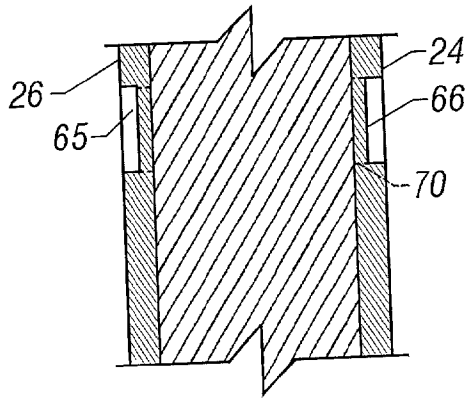

FIG. 4

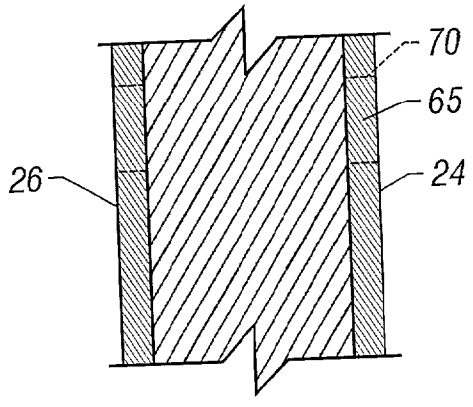

FIG. 5

SYSTEM AND METHOD FOR PROVIDING VIEWPORTS IN A CLOSED WALL FABRICATION PROCESS

SPECIFICATION

[0001] 1. Field of the Invention

[0002] The invention relates to the building industry. More specifically, the invention relates to an inspection system and method for providing viewports in a closed wall.

[0003] 2. Background of the Invention

[0004] In conventional construction, walls are fabricated by erecting on a foundation a structural frame that is usually formed from timber. The frame is subsequently clad internally with a suitable material, which is usually finished to conceal the joints with a wall covering. An exterior wall is usually made from concrete block, brick veneer, or a suitable cladding material that is fastened to the timber frame. Common exterior cladding materials include wood, fiber-reinforced cement, and aluminum.

[0005] Inspections are usually required throughout the construction. For example, formal inspections are dictated by governmental codes and regulations and or privately required measures. A building inspector will inspect the quality of materials, spacing, size, and placement of structural members, the member's attachment to adjacent surfaces, such as the foundation and roof, and other aspects, as is necessary. Similarly, an inspection is typically required on electrical, plumbing, and other services installed in the building. The inspections will typically occur prior to enclosing the wall, ceiling, or other building section, because the services or structural members are hidden after such closure.

[0006] In recent years, the cost of building using conventional materials has escalated rapidly. Further, new methods have been sought to make the buildings more thermally efficient and faster to construct. One technology is the use of composite panels, also known as "closed wall systems" or simply "closed walls." Such closed walls typically include one or more structural materials and one or more, typically two, surface materials, also known as "skins" that enclose the members therebetween. Some closed walls include insulating board sandwiched or otherwise disposed between the skins with or without structural or other members. Typically, the closed walls are made in relatively large sections, such as four feet by eight feet or larger. The closed walls can be brought to the building site, set in place, and fastened to rapidly erect walls or other portions of the building. Further, the materials used in the closed walls can be made from non-conventional materials and promote ecological conservation.

[0007] Despite such advantages, acceptance of the closed wall technology has been slow. Current standards can dictate a formal inspection, requiring visual inspection of the interior construction. This need is problematical in closed wall systems. For example, important features in a closed wall can no longer been seen, once the panel is erected at the job site.

[0008] The ability of the inspectors, framers, builders, superintendents, and other people to inspect the structural members is believed to at least in part cause some hesitancy to its widespread use. Presently, for an inspector or other interested person to examine the wall panel in a system requires either that one or both skins be removed. However, the skin removal adds time and complexity to the construction process. Alternatively, individuals can cut unnecessary and often ill-advised holes in the closed wall searching for a particular structure that may lie beneath the skin. Damage can be caused in attempting to find the structure, so that the wall panel loses its structural integrity or causes subsequent inspection failure on the building. Thus, the process can actually add time and expense to an otherwise orderly construction.

[0009] Thus, there remains a need for a closed wall system that can readily allow inspection in a controlled and predetermined manner.

SUMMARY OF THE INVENTION

[0010] The present invention provides one or more viewports formed at predetermined locations that allow a person performing an inspection to view an inside member of a closed wall system. The viewports can be disposed at predetermined locations that do not significantly impair the structural characteristics of the outward layers or inside members. In at least one embodiment, the viewports are formed in one or more outward layers during fabrication of a closed wall system. Generally, the closed wall system can be mass-produced in a manufacturing facility, although the closed wall system may be fabricated at the job site.

[0011] In one embodiment, the invention provides an inspection system for a closed wall, comprising a closed wall having at least one inside member disposed between at least two outward layers of material and at least one viewport formed at a predetermined position in at least one of the two outward layers during fabrication of the closed wall.

[0012] Further, the invention provides a method of preparing an inspection system for a closed wall, comprising providing at least one inside member, forming at least one viewport in at least one outward layer of material, and enclosing the inside member between the outward layer having the viewport and a second outward layer.

[0013] The invention also provides an inspection system for a closed wall, comprising a closed wall having at least one inside member disposed between at least two outward layers of material, and at least one viewport formed at a predetermined location in at least one of two outward layers during fabrication of the closed wall and prior to covering of the outward layer having a viewport with the inside member, the location being determined by a known or anticipated location of the inside member in the closed wall.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] A more particular description of the invention, briefly summarized above, may be had by reference to the embodiments thereof that are illustrated in the appended drawings and described herein. However, it is to be noted that the appended drawings illustrate only some embodiments of the invention. Therefore, the drawings are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

[0015] **FIG. 1** is a perspective schematic view of a building having a closed wall.

[0016] **FIG. 2** is a perspective schematic view of a closed wall with an open viewport.

[0017] **FIG. 3** is a cross-sectional schematic view of a closed wall with a closed viewport.

[0018] **FIG. 4** is a cross-sectional schematic view of a closed wall with another closed viewport.

[0019] **FIG. 5** is a cross-sectional schematic view of a closed wall with another closed viewport.

DETAILED DESCRIPTION OF THE INVENTION

[0020] **FIG. 1** is a perspective schematic view of a building having a closed wall. A building **10** is representative of any building upon which a closed wall may be installed. Building **10** can include residential, commercial, industrial, and other types of structures. The building can include any shape that can be constructed such as rectangular, square, multi-story, single-story, geodesic, or any other shape in which a building may be made. Generally, a building will include a foundation **12**, walls **14**, and roof **16**.

[0021] The foundation **12** can be any typical foundation, such as but not limited to, a slab, wood, beam, steel, raised platform, and other types of underlying supports. Further, the foundation can be the upper level of a lower story in a multi-story building. Generally, one or more walls **14** form a supporting surface between the foundation and a roof. The term "wall,""walls," and like terms are used broadly herein and can include exterior or interior walls that may be vertical, horizontal, or at angles to the foundation, as is appropriate to the particular building design.

[0022] The roof **16** is shown to be an angled roof as would generally exist in many buildings. However, it is to be understood that the roof can have any shape as is appropriate, including a flat roof found in many buildings. Further, the building **10** can have one or more doors **18** and one or more windows **20**. An exterior **22** of the building **10** generally includes an exterior medium such as brick, stone, metal, wood, fiberglass, composites, and other materials to protect from weather, theft, and other aspects known to those with ordinary skill in the art.

[0023] A closed wall, shown in more detail in **FIG. 2**, can be installed inwardly of the building exterior **22**. The closed wall generally is a composite wall containing a first outward layer **24** and a second outward layer **26** with one or more inside members enclosed or otherwise disposed therebetween. One or more of the outward layers **24**, **26** can include a variety of structural or nonstructural material. For example, the outward layers can include materials made from sheetrock, plywood, particle board, oriented strand board (OSB), laminates, fiberboard, insulation boards and other insulating materials, films, plastics, metals, and other building materials. The second outward layer can be made of similar materials.

[0024] The term "inside member" is intended to include any member(s) or feature(s) that can be disposed or formed at least partially between the first and second outward layers **24**, **26**. For example, some inside members can be studs, insulation, headers, elements of the plumbing or electrical systems, such as pipes, vents, conduits, wires, and rigid and flexible insulation, or other elements as can exist between the two outward members in a building. Further, the inside members can include openings, such as holes of various sizes and shapes, access ports, and other void areas. In at least one embodiment, a standard closed wall thickness can be formed from about 7/16 inch thick outward layers and each about 3½ inches thick inside members, although the thicknesses can vary depending on the building and materials used. Insulative, plumbing, electrical, and other elements can be installed therein.

[0025] One exemplary embodiment of various inside members that can generally be included in a closed wall is shown in the exemplary embodiment of **FIG. 1**. Full-length studs **28**, generally known as kings studs, are used to support the wall along its length. Shorter studs **30**, known as Jack studs, can be used to support headers **32** that can span distances laterally between king studs **28**. Insulation **29** can be placed between one or more of the studs and throughout the building structure. Shorter supports **34** may be used to support other headers **36** below building structures, such as the window **20**. A structure supporting the roof **16**, generally termed herein upper structure **38** can include joists, rafters, braces, and other supports. Further, the upper structure **38** can include girders, beams, and other supports for multi-story building structures.

[0026] In at least one embodiment, one or more of the outward layers can be laminated or otherwise coupled to the inside member, such as a insulation foam core, during the fabrication process. Alternatively, the outward members can be provided and the foam core or other inside member can be formed between the outward layers.

[0027] Other inside members disposed between the outward layers **24**, **26** can include elements of the plumbing system **40**, such as pipes, vents, drains, and other plumbing elements. Similarly, the inside members disposed in the space between the outward layers **24**, **26** can include elements of an electrical system. Such elements can include conduits, wires, boxes, switches, and other typical electrical elements.

[0028] An interior **44** is formed inward of the closed wall. As described above, generally an inspector can inspect the structure from the interior **44** of a typical construction and determine that the various members are satisfactory. With the closed wall system, the inside elements described above are not visible and not subject to ready inspection to determine the sufficiency, quality, and presence of the inside member(s). The term "inspector" is used broadly herein as intended to include any person or device that views, determines, ascertains, measures, examines, or otherwise inspects one or more items of interest. The viewports of the present invention, shown in **FIG. 2**, provide an ability to readily inspect interior portions of the closed wall.

[0029] **FIG. 2** is a perspective schematic view of a closed wall with an open viewport. The closed wall **50** generally includes a first outward layer **24** and a second outward layer **26**. The inside member **51** can include one or more elements such as studs **52**, **58**, and **60** and other structural elements, and insulation member **54**. The insulation member **54** can include any insulation material generally used in closed wall systems, including relatively rigid foam cores, polyurethane, polystyrene, EPS, XPS, and polyisocyanurate, more flexible materials, such as fiberglass batting, or other materials known to those with ordinary skill in the art. Further, the

inside member(s) **51** can include plumbing elements **56**, such as pipes and other elements described above, and electrical element(s) **57** such as an electrical wire, conduit, and other general electrical elements, as well as features, such as openings through which the plumbing, electrical and other elements can be disposed or accessed in the closed wall. Other systems can be included within the gamut of inside member(s) **51**, as would generally be found in a building structure.

[**0030**] The present invention allows an inspection of the inside members in a predetermined and controlled manner. The inspection system of the present invention includes one or more viewports **62** formed at predetermined locations in one or more of the outward layers **24**, **26**. The predetermined locations of the viewports can be determined by the known or anticipated locations of the inside member(s) to be inspected. In at least one embodiment, the viewport(s) **62** can be formed through the thickness of the outward layer(s). If desired, the viewport can be resealed upon completion of the inspection by a suitable insert, plug, or fill material.

[**0031**] In at least one embodiment, the viewports **62** can be spaced at predetermined intervals to account for general spacing of structural members, requested spacing by an inspector or architect, or some other requirements. The viewports **62** can be spaced in line or staggered at some predetermined configuration. If the viewports are in a vertical closed wall, then it may be advantageous to have the viewports at some position that would readily facilitate viewing through the viewports, such as an average eye-level height.

[**0032**] The predetermined viewport positions can advantageously be at junctions where such positions have minimal, if any, structural, visual, insulative, or other effect upon the associated outward layer. The viewports can be made at specifically selected strategic locations to view one or more inside members, such as junctions between studs and headers, junctions having multiple inside members, angles or bends in piping that may need inspection for leaks, and other locations based on selected criteria as may be appropriate in general or for job-specific closed walls. Alternatively, the viewports can be made at predetermined positions that are uniformly spaced in the closed walls. Further, the viewports can be a standard size or may vary in shape and size depending on the location and size of the inside member(s) to be viewed, such as viewport **62**'. Some viewports can be at least partially closed, such as viewport **62**", including viewports described in FIGS. **3-5**. In at least one embodiment, the viewport can be covered by a transparent or translucent material so that the inside member is still viewable, and thus still considered an open viewport herein.

[**0033**] The viewports can be formed after coupling the inside member(s) with the outer layer(s). Viewports can also be formed prior to coupling the outward layer(s) with the inside member. Generally, the outward layers are coupled to insulative or structural members. The viewports can be formed in the outward layers after or prior to such coupling. The term "coupling" is used broadly herein and is intended to include any method of securing, binding, bonding, fastening, attaching, joining, inserting therein, forming thereon or therein, or otherwise associating one or more of the layers and members together. Generally, the inside members are not otherwise visible from the external faces of the outward layers after assembly of the wall into the building structure and sometimes after fabrication of the closed wall itself.

[**0034**] Further, the viewports can be formed on both outward layers. For example, the viewports can be formed in the outward layer **24**, so that inspections can be made of the closed wall attachment to the foundation or adjacent structure. Other viewports can be formed in outward layer **26**, so that inspections of plumbing, electrical, framing members, such as pipes, wiring, conduit, studs and headers, and other inside members may be made even after the exterior **22** of the building is installed.

[**0035**] The viewport can be created consistently in predetermined positions in a manufacturing environment. Alternatively, the viewport can be formed in the outward layers at other stages of the overall fabrication process of the closed wall. In some embodiments, the one or more of the outer layers may be coupled with the inside member at the job site. The viewports can be formed at a job site in the closed walls at predetermined positions.

[**0036**] The viewports can be produced in any manner known to those with ordinary skill in the art including, but not limited to, manually, power-assisted such as with electrical and pneumatic tools, semi-automatically with an operator directing the formation of the viewport, or in an automatic, integrated system as part of the outward layer manufacturing process. Such an automatic integrated system can include, for example, mixers, presses, ovens, conveyors, punches, and other equipment, as would be apparent to those with ordinary skill in the art, given the understanding provided by the description of the invention contained herein.

[**0037**] In one embodiment, a viewport can be formed in the first outward layer to align with any inside member **51** disposed between the outward layers **24**, **26**, such that the inside member can be viewed either directly or at some angle through a viewport. Further, a viewport can be formed in the other outward layer and can be aligned with a viewport in the first outward layer so that by looking through one viewport the other viewport can be seen. This positioning may facilitate ready inspection of these inside members. The viewport can be plugged or otherwise closed after inspection to facilitate thermal insulative properties, air flow, privacy, and other aspects.

[**0038**] **FIG. 3** is a cross-sectional schematic view of a closed wall with a closed viewport. In this embodiment, a viewport **65** does not extend through the thickness of the corresponding outward layer and is closed. A closed viewport **65** can be formed through a portion of the corresponding outward layer, generally leaving a relatively thin portion **66** of the corresponding outward layer. In one embodiment, the closed viewport **65** can be formed on an inside surface of the outer layer, so that the viewport is substantially hidden from the outside. Alternatively, the viewport can be formed on an outside surface of the outer layer, as described in **FIG. 4**.

[**0039**] The thin portion **66** can be removed if desired at a later time to allow an inspection of the inside member **51**. For example, the thin portion **66** can be removed mechanically with a hammer or screwdriver, chisel, or automatically with power tools, such as a router, or other devices as could be used in a typical construction job site. Further, the

viewport can have a weakened portion **70** about its periphery or another portion of the viewport to facilitate removal of at least part of the thin portion **66**. The weakened portion **70** can be formed, for example, by perforating, die cutting, and other methods of weakening a material to facilitate later removal as is known in the art. The weakened portion **70** can extend fully through the thickness of the thin member and/or outer layer or partially therethrough.

[**0040**] An indicator **66** can be placed on an opposite surface from the closed viewport **65** to indicate a location of the viewport **65** when the viewport **65** is hidden from external view. In at least one embodiment, the indicator **66** can be formed about the periphery or another portion of the viewport and include the weakened portion **70**. The indicator can also include a marking, indention, protrusion, or other element that would indicate the presence of a viewport. Thus, numerous viewports **65** on the material layer can be formed in one or more of the outward layers, but hidden from external view and accessed at discretionary times and places.

[**0041**] If the viewport **65** is opened, the opening can be closed if desired subsequent to the inspection by inserting plugs, fill material, or other elements that restrict the sight, air flow, noise, and disadvantageous conditions. Alternatively, the thin portion **66** can be replaced with a translucent or transparent member, so that the closed viewport **65** can function as an open viewport, in that the inside member **51** can be viewed through the viewport.

[**0042**] **FIG. 4** is a cross-sectional schematic view of a closed wall with another embodiment of the closed viewport. The embodiment is similar to the embodiment described in reference to **FIG. 3**. The viewport **65** is formed toward the outer surface of the outward layer(s) **24**, **26** and the thin section **66** is formed inwardly from the outer surface. In this and other embodiments described herein, a weakened portion **70** can be formed in the thin section and/or outward layer to facilitate removal of at least part of the thin section by perforating, die cutting, or by other methods of at least partially weakening materials to facilitate later removal, as is known in the art.

[**0043**] **FIG. 5** is a cross-sectional schematic view of a closed wall with another embodiment of the closed viewport. In some embodiments, the closed viewports **65** may be formed without the thin member, for example, by using a weakened portion **70**. The weakened portion **70** can define the periphery of the viewport in the outer layer, so that if the weakened portion is removed, the viewport is at least partially open. The weakened portion can extend partially or fully through the thickness of the outer layer.

[**0044**] While the foregoing is directed to various embodiments of the present invention, other and further embodiments can be devised without departing from the basic scope thereof. For example, the various methods and embodiments of the invention can be included in combination with each other to produce variations of the disclosed methods and embodiments. Discussion of singular elements can include plural elements and vice-versa. Also, any directions shown or described such as "top,""bottom,""left,""right,""upper," "lower," and other directions and orientations are described herein for clarity in reference to the figures and are not to be limiting of the actual device or system or use of the device or system. The device or system can be used in a number of directions and orientations. Further, the order of steps can occur in a variety of sequences unless otherwise specifically limited. The various steps described herein can be combined with other steps, interlineated with the stated steps, and/or split into multiple steps. Additionally, the headings herein are for the convenience of the reader and are not intended to limit the scope of the invention.

[**0045**] Further, any references mentioned in the application for this patent as well as all references listed in the information disclosure originally filed with the application are hereby incorporated by reference in their entirety to the extent such may be deemed essential to support the enabling of the invention(s). However, to the extent statements might be considered inconsistent with the patenting of the invention(s), such statements are expressly not meant to be considered as made by the Applicants.

What is claimed is:

1. An inspection system for a closed wall, comprising:

a) a closed wall, having at least one inside member disposed between at least two outward layers of material; and

b) at least one viewport formed at a predetermined location in at least one of the two outward layers during fabrication of the closed wall, the viewport location being determined by a known or anticipated location of the inside member in the closed wall.

2. The system of claim 1, wherein the viewport is positioned to align with the inside member, so that the at least one inside member is observable through the viewport when the viewport is open.

3. The system of claim 1, wherein each of the two outward layers comprises a viewport formed therein.

4. The system of claim 1, wherein at least one viewport is open.

5. The system of claim 1, wherein at least one viewport is closed.

6. The system of claim 5, wherein the outward layer having the closed viewport comprises a location indicator of the closed viewport.

7. The system of claim 5, wherein the closed viewport is formed in the outward layer prior to coupling of the outward layer with the inside member.

8. The system of claim 1, wherein the viewport is formed in the outward layer after coupling of the outward layer with the inside member.

9. The system of claim 1, further comprising a building having at least a foundation and a roof associated with the closed wall system.

10. The system of claim 1, wherein a first viewport in a first outward layer is positioned to allow one or more first inside members to be viewed and a second viewport in a second outward layer is positioned to allow one or more second inside members to be viewed.

11. The system of claim 1, wherein a first viewport in a first outward layer is positioned to align with a second viewport in a second outward layer with the inside member disposed between the two outward layers.

12. A method of preparing an inspection system for a closed wall, comprising:

a) providing at least one inside member;

b) coupling at least one outward layer with the inside member; and

c) forming at least one viewport in at least one outward layer of material during fabrication of the closed wall.

13. The method of claim 12, wherein the viewport is formed in the outward layer after coupling of the outward layer with the inside member.

14. The method of claim 12, wherein the viewport is formed in the outward layer prior to coupling of the outward layer with the inside member and wherein the outward layer is aligned with the inside member so that the inside member is visible through one or more viewports when the viewports are open.

15. The method of claim 12, wherein forming the viewport comprises forming the viewport through the outward layer so that the viewport is open.

16. The method of claim 12, wherein forming the viewport comprises forming at least one viewport through only a portion of a thickness of the outward layer so that the viewport is closed.

17. The method of claim 16, further comprising indicating a location of the closed viewport on an opposite surface of the outward layer having the closed viewport.

18. The method of claim 12, further comprising forming a first viewport in a first outward layer and a second viewport in a second outward layer and aligning the first and second viewports during fabrication of the closed wall system.

19. The method of claim 12, further comprising allowing one or more first inside members to be viewed through at least a first viewport and one or more second inside members to be viewed through at least a second viewport.

20. The method of claim 12, further comprising assembling the closed wall to at least a portion of a building structure and assembling further building portions to the closed wall.

21. An inspection system for a closed wall, comprising:

a) a closed wall, having at least one inside member disposed between at least two outward layers of material; and

b) at least one viewport formed at a predetermined location in at least one of the two outward layers during fabrication of the closed wall, and prior to coupling of the outward layer having the viewport with the inside member, the viewport location being determined by a known or anticipated location of the inside member in the closed wall.

* * * * *