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Francavilla

(54) **COMPOSITE CONCRETE AND FRAMING SYSTEM AND METHOD FOR BUILDING CONSTRUCTION**

(76) Inventor: **John Joseph Francavilla**, Royal Palm Beach, FL (US)

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(52) **U.S. Cl.**

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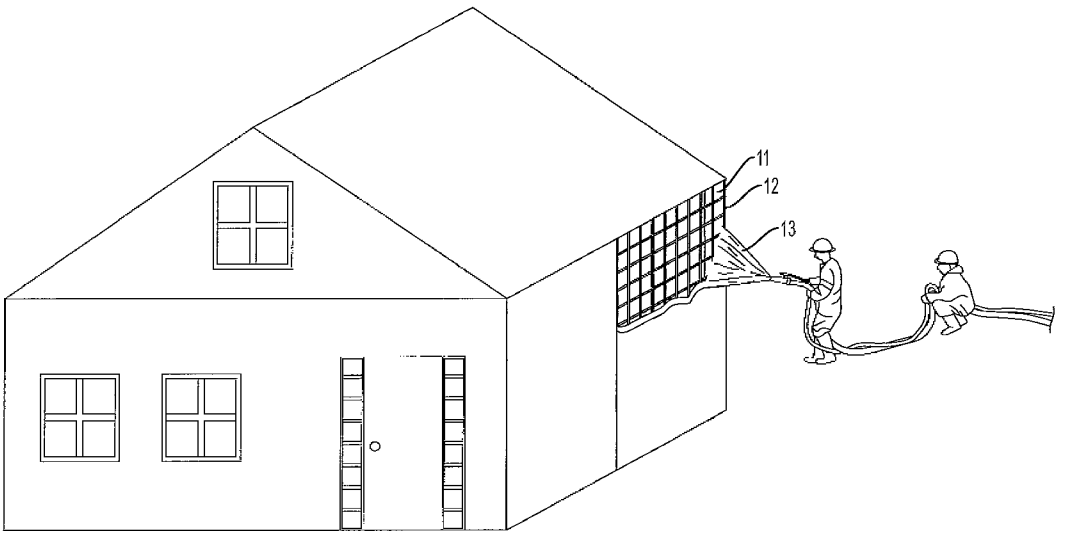
(57) **ABSTRACT**

A composite building construction system and method comprising a frame, wallboard, and a concrete layer wherein the wallboard is attached to an exterior side of the frame and the concrete layer is provided on the wallboard. A wire grid is attached to and spaced apart from the wallboard to provide support for the concrete layer. The resulting building construction composite provides enhanced strength and stability due to the relatively thick layer of concrete combined with the frame, which may comprise steel. The wallboard comprises blueboard or similar insulating wallboard material that preferably includes concrete adhesion characteristics. The frame comprises outer framing members and cross-members each of which may include apertures for receiving plumbing and/or electrical wires. The apertures may also receive conduits to protect the plumbing and electrical wires. An interior side of the frame is configured to received drywall or other interior housing finishing product.



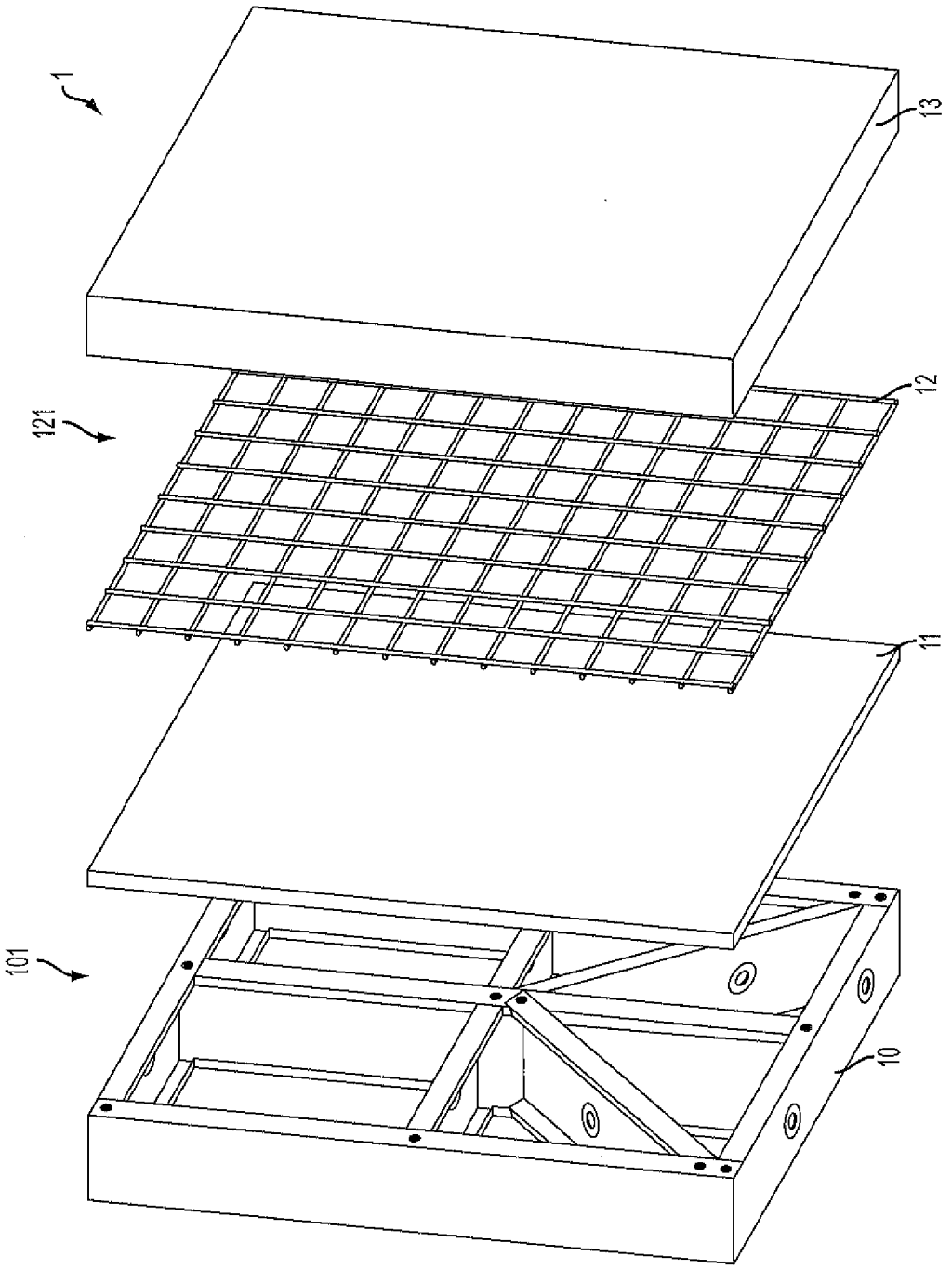



FIG. 1

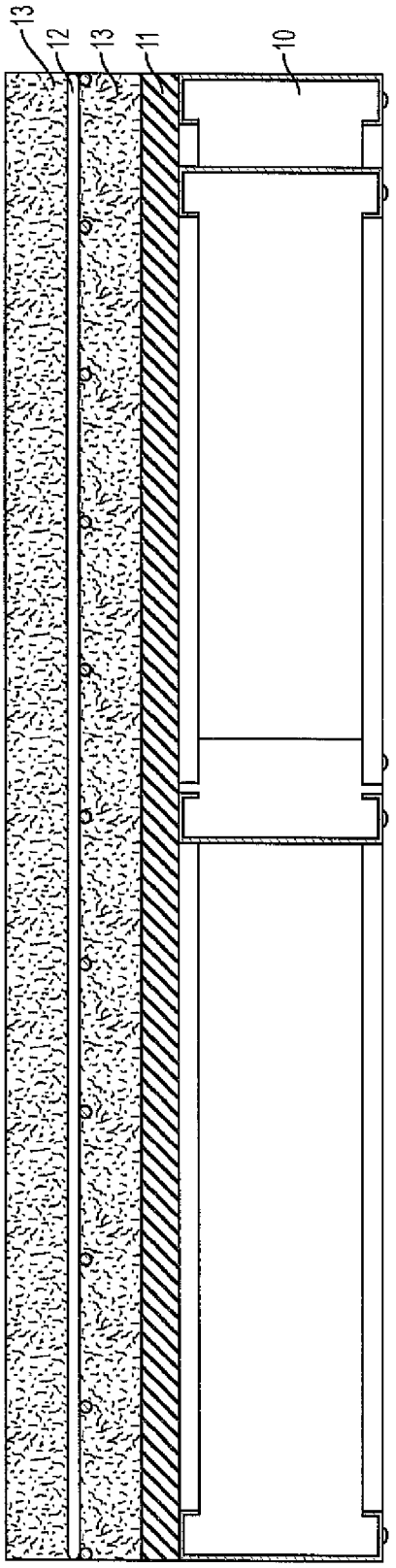



FIG. 2

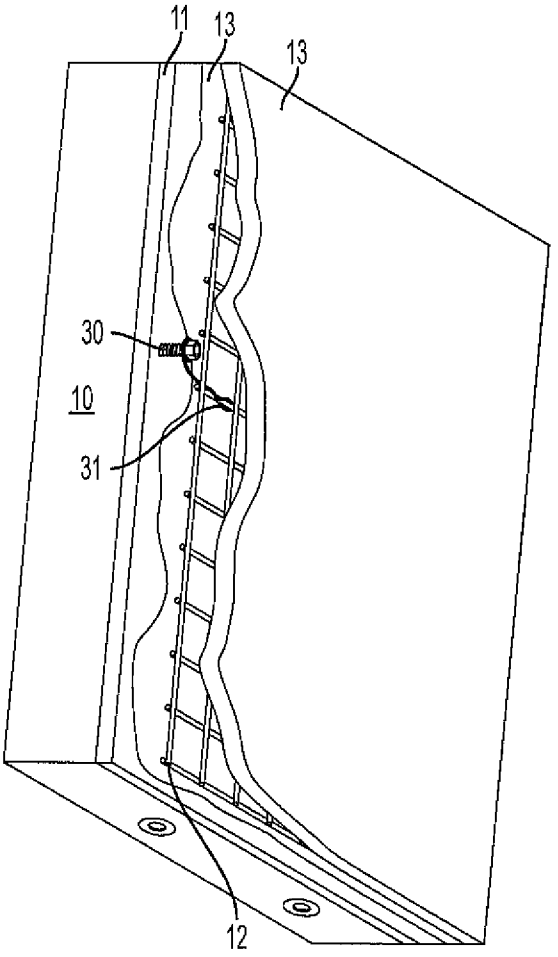



FIG. 3

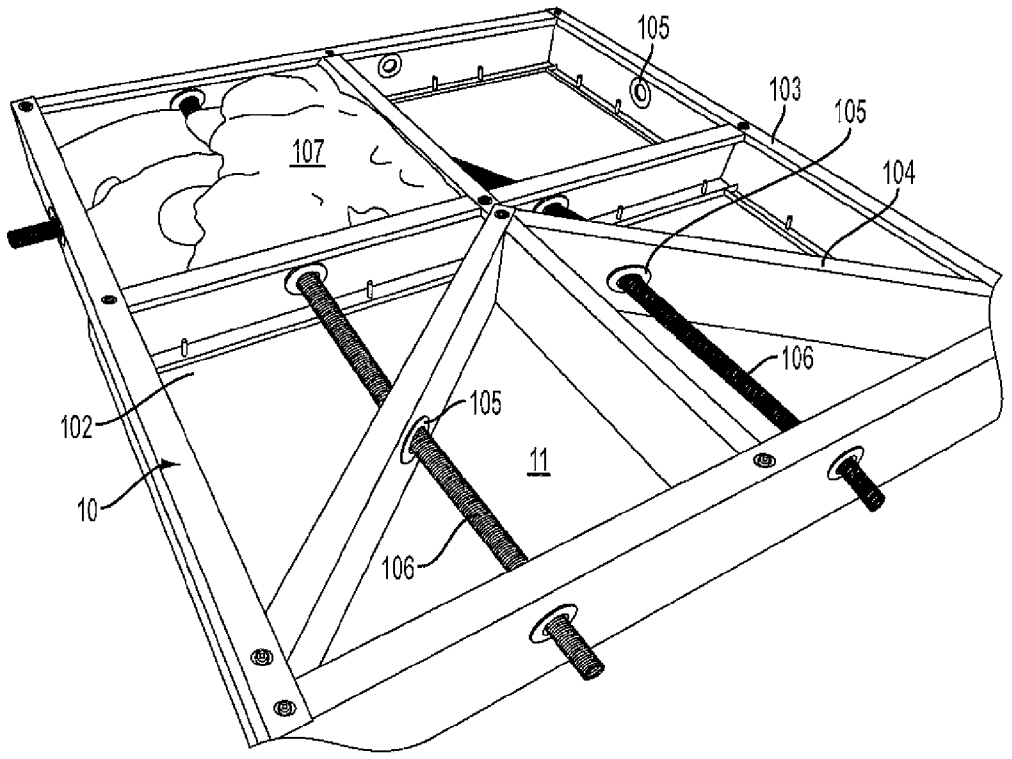



FIG. 4

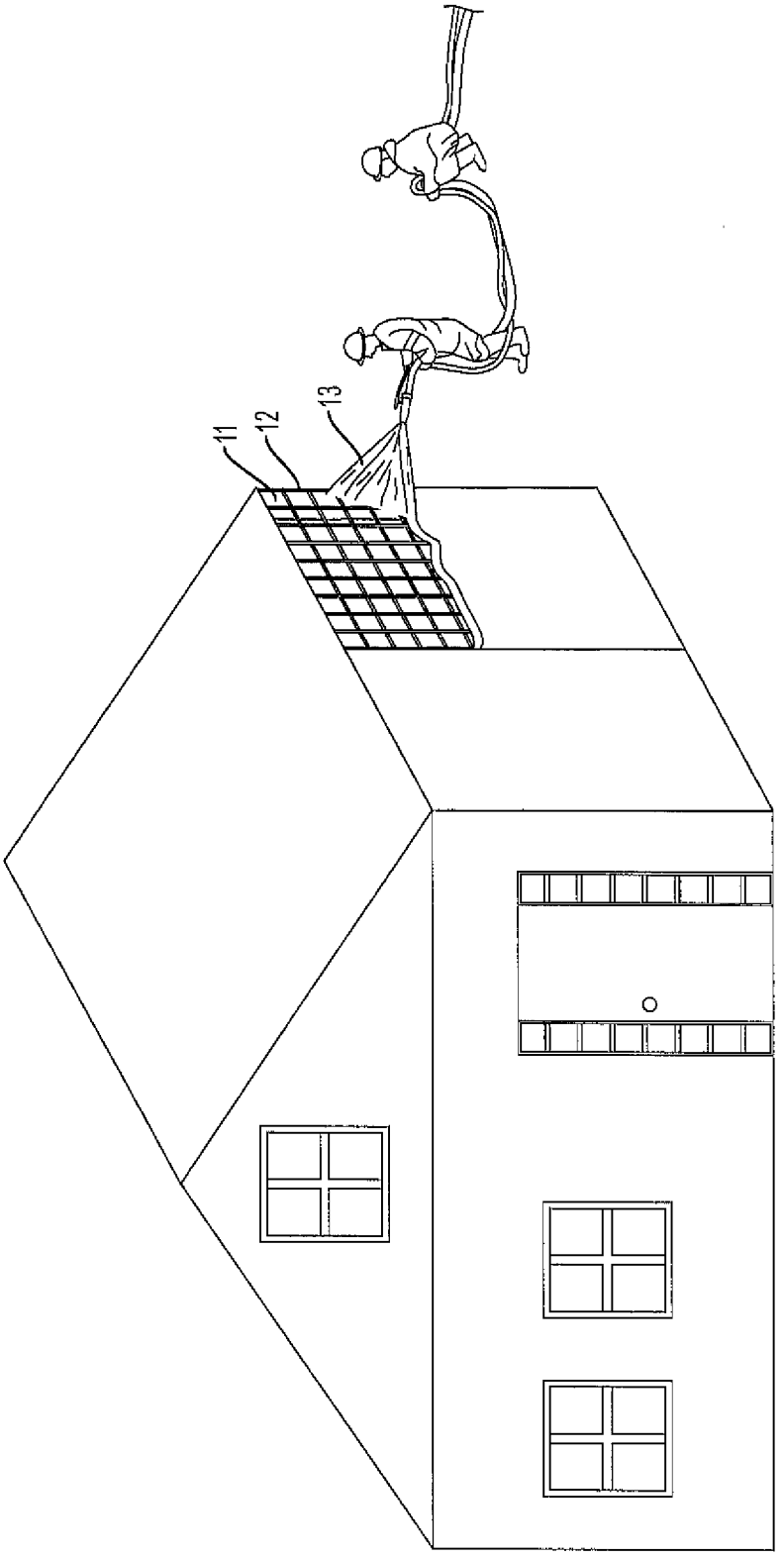



FIG. 5

# COMPOSITE CONCRETE AND FRAMING SYSTEM AND METHOD FOR BUILDING CONSTRUCTION

## CROSS REFERENCE TO RELATED APPLICATIONS

**[0001]** This application claims the benefit of U.S. Provisional Application No. 61/477,677 filed on Apr. 21, 2011.

## BACKGROUND OF THE INVENTION

**[0002]** 1. Field of the Invention

**[0003]** This invention relates to systems and methods of building construction and more particularly to systems and methods including a composite of concrete, framing, and other materials and structures.

**[0004]** 2. Description of Related Art

**[0005]** Conventional building construction typically comprises three primary systems and methods: (1) wood stud construction; (2) concrete block construction; and (3) concrete panel construction. Wood stud construction system requires skilled carpenters to assemble the pieces and cut lumber according to structural drawings that require skilled interpretation. Concrete block construction, wherein the perimeter of a housing unit is comprised of arranged cinder blocks or concrete blocks in a structurally sound fashion, is slow to put into place and requires a large number of skilled masons to carry out effectively. Concrete panel construction, wherein pre-cast panels are put into place against or in conjunction with a framing system, requires heavy equipment to lift and place the concrete panels, as well as a skilled work force to build the structure that provides the framing template for the panels.

**[0006]** Accordingly, the development of better building systems for constructing low cost, efficient and easily built housing units has been slowed by the need for skilled labor to assemble the components required for the housing unit. In many locales, skilled labor is in short supply and/or prohibitively expensive which has restricted the ability to construct low cost housing units en masse, particularly in underdeveloped countries. Other problems with present building construction technology include the need to build housing units at a low cost and quickly, the ability to build housing units having a resilient construction that does not require a great deal of maintenance, is strong structurally, and provides desired insulation from the elements. Thus, in many countries, the aspirations of having modernized housing units have slowly waned.

**[0007]** The present invention provides an improved building construction system and method designed to addressed the problems outlined above and provides a systemized product that provides housing for residential or commercial use, can be economically constructed, does not need high level and expensive skilled labor, is extremely strong and weather resistant, has excellent thermal insulation, and requires low maintenance. It is, therefore, to the effective resolution of the aforementioned problems and shortcomings of the prior art that the present invention is directed. However, in view of the building construction system and methods in existence at the time of the present invention, it was not obvious to those persons of ordinary skill in the pertinent art as to how the identified needs could be fulfilled in an advantageous manner.

## SUMMARY OF THE INVENTION

**[0008]** The present invention provides a composite building construction system, comprising a frame, wallboard, and a concrete layer wherein the wallboard is attached to an exterior side of the frame; and the concrete layer is provided on the wallboard. In some embodiments, a wire grid is attached to and spaced apart from the wallboard to provide support for the concrete layer. In some embodiments, the concrete layer is 3-inches thick. The resulting building construction composite provides enhanced strength and stability due to the relatively thick layer of concrete combined with the frame, which may comprise steel. The wallboard comprises blueboard or similar insulating wallboard material that preferably includes concrete adhesion characteristics. The frame comprises outer framing members and cross-members each of which may include apertures for receiving plumbing and/or electrical wires. The apertures may also receive conduits to protect the plumbing and electrical wires. An interior side of the frame is configured to received drywall or other interior housing finishing product. Insulation may also be disposed within the frame itself for added thermal insulation.

**[0009]** A housing unit or building may be constructed by providing one or more frame sections each prefabricated and coded according to a building plan. The frame sections are assembled together to form a housing structure. Then the wallboard is attached to the exterior sides of the frame sections, the wire grid is attached to the wallboard, and then concrete is sprayed over the wire grid and wallboard until the relatively thick concrete layer is formed. Once the concrete has been cured, it can be finished with paint, stucco, or other known housing unit finish materials. The interior side of the frame can be finished with drywall.

**[0010]** The structural integrity of the present construction system is greatly enhanced due to the relatively thick concrete layer applied to the wallboard-frame combination. The completely structure is capable of withstanding hurricane force winds, earthquakes, and other weather conditions whereby the structure exceeds national and local building codes to that effect. The present invention provides a substantial improvement over the prior art with respect to the simplicity and cost of construction, as it does not require skilled laborers such as masons, carpenters, and the like. The prefabrication and coding of the frame sections enhances the ease-of-build even more.

**[0011]** Accordingly, it is an object of the present invention to provide a structurally sound and insulative building construction composite.

**[0012]** It is yet another object of the present invention to provide a building construction system and method that does not require skilled labors to assemble and construct.

**[0013]** It is yet another object of the present invention to provide a building construction system and method that includes a relatively thick concrete layer provide substantial structural rigidity at a decreased cost.

**[0014]** It is yet another object of the present invention to provide a building construction system and method that can be assembled more quickly than typical construction methods, even with the use of unskilled laborers.

**[0015]** In accordance with these and other objects which will become apparent hereinafter, the instant invention will now be described with particular reference to the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0016]** FIG. **1** is an exploded schematic of one embodiment of the building construction system of the present invention.

**[0017]** FIG. **2** is a cross-sectional cutaway view of one embodiment of the building construction system of the present invention.

**[0018]** FIG. **3** is a perspective view of one embodiment of the building construction system of the present invention.

**[0019]** FIG. **4** is another perspective view of one embodiment of the system of the present invention.

**[0020]** FIG. **5** is a schematic of a concrete layer being sprayed onto the wallboard/frame in accordance with the present system and method.

## DETAILED DESCRIPTION

**[0021]** The present invention overcomes the disadvantages of the prior art by incorporating a combination of sprayed concrete onto an insulation board which is cladding a steel stud frame. With reference to FIG. **1**, shown is an exploded schematic of one embodiment of the system of the present invention arranged and constructed in accordance with one embodiment of the method of the present invention. Shown is a section, or a portion of a composite construction system **1**, comprising a frame **10**, a wallboard **11**, a support grid **12**, and a concrete layer **13**. The system **1** is provided as an wall structure for a building or housing unit and will typically be assembled in sections as described in detail below.

**[0022]** With reference to FIGS. **1** and **2**, the wallboard **11** is fastened to and disposed on an exterior side **101** of the frame **10**. In some embodiments, wallboard **11** is fastened to frame **10** by one or more bolts **30** received through wallboard **11** and terminating within a portion of frame **10** as shown in FIG. **3**. A plurality of bolts **30** may be provided through wallboard **11** and into frame **10** to provide a secure attachment of the two components. Other fasteners may be used instead of bolts, such as screws, nails, staples, and the like. The support grid **12** is spaced apart from but attached to wallboard **11**. Grid **12** may comprise a wire mesh grid, a rebar grid, or similar rigid grid. As shown in FIG. **3**, in some embodiments, grid **12** is attached to wallboard **11** by ties **31** which are received around both the grid **12** and a bolt **30**. Other means of connecting wallboard **11** to grid **12** may be employed, including brackets, screws, bolts, staples, and the like.

**[0023]** In some embodiments, concrete layer **13** is sprayed over grid **12** such that the concrete adheres to wallboard **11** and has a thickness extending away from wallboard **11**. Grid **12** provides structural support for the adherence of concrete layer **13** to wallboard **11**. In some embodiments, concrete layer **13** is applied in multiple thin-layer applications in order to assure adherence and structural rigidity with respect to wallboard **11**. As depicted in FIG. **2**, concrete layer **13** is applied such that grid **12** is disposed within the concrete layer **13**; or, said differently, concrete layer **13** is disposed on either side of grid **12** and, in many cases, will be disposed through grid **12** wherein grid **12** includes interstitial gaps **121** (FIG. **1**) by way of its grid configuration. In some embodiments, it is preferred that concrete layer **13** have a thickness of approximately 2-3 inches extending from the wallboard however the thickness may vary depending on the desired application and building plan.

**[0024]** In some embodiments, the stud frame **10** of the present invention is constructed through use of a fabricating machine which forms the studs from coiled metal (steel, aluminum, and the like) and marks the components with coding to allow for quick, easily assembled construction by workers who do not need high level construction skills, rather they need only to match the markings for assembly. FIG. **4** shows an example of one section of frame **10** shown having a generally square or rectangular shape. Shown is frame **10** from the perspective of interior side **102** with wallboard **11** attached to the exterior side of frame **10**. Frame **10** may include outer framing members **103** and one or more cross members **104** providing a riding structural support system for building construction. In some embodiments, the framing members **103** and **104** include one or more apertures **105** punched there-through. The apertures **105** are configured to receive and channel electrical wiring, plumbing, and the like. In some embodiments, conduits **106** are provided through apertures **105** and provide protection for wiring or plumbing passed there-through. Further, the inside of the frame **10** at interior side **102** of frame **10** may receive and contain insulation material **107** which may be poured, sprayed, or applied in sheets thereto. Accordingly, the interior side **102** is typically the side facing the inside of the particular building or home and the exterior side **101** (which receives wallboard **11**, grid **12**, and cement layer **13**) is the exterior of the building or home. The interior side **102** may be finished with typical interior wall material such as drywall, plasterboard, sheet rock, and the like.

**[0025]** The result of the present invention is a combined building or housing frame **10** structure covered with an insulating exterior wallboard **11** to which a sprayed concrete layer **13** has been applied. Each frame **10** as described above comprises at least a portion of a wall of a building or housing structure. This configuration provides substantial strength and durability and exceeds typical hurricane, earthquake and other weather strength rating requirements presently used throughout the world. This enhanced strength is achieved primarily due to the relatively thick concrete layer **13** combined with the rigid frame **10**. In accordance with the present invention, a housing unit can be assembled in a matter of three or four days rather than months by utilizing the building construction system and method of the present invention; minimal skill is needed by the assembly crews and fabrication can be customized to meet local codes, plumbing and electrical requirements. Most single family units are anticipated to be in the twelve hundred to fifteen hundred square feet of living space. The units can be built as independent units or in multiple family configurations and, in that sense, the particular size and configuration of a given housing unit built in accordance with the present invention is not limiting.

**[0026]** The wall configuration, square footages, windows, doors, electrical, plumbing, ventilation and other requirements are placed into a take off for analyses by a computer software program for calculation of number of feet needed for frames **10**, frame **10** dimensions and placement, cut outs for placement of plumbing and electrical wires, placement of windows, doors and ventilation needs, as well as sizing to meet local and national codes and best practices for the location where the homes are going to be built. The result of the multi-stage analyses is a computerized output of frame **10** requirements that can be fed into a frame fabricating machine. The frame fabricating machine then can produce the frames **10** in sections, including the cross-members and outer members needed for the construction of the unit. The frames are typically fabricated from rolled coils of sheet metal material such as steel or aluminum but may also comprise wood or

other materials as suitable for the particular application. In some embodiments, a steel frame section having a 3-inch concrete layer applied thereto is capable of withstanding at least 50,000 psi of pressure and therefore is preferred as a weather-rated material in certain applications. As the entire frame structure is fabricated typically in discrete sections, the frame sections are marked at each end with a coding number. Headers and sills are likewise marked with numbers at all locations where they will interact with the frame sections or any bracing pieces, cross-members, and the like. Typically, the frame sections are produced in the order of assembly, so that the pieces are assembled in the order of fabrication.

**[0027]** When constructing the actual building, the unit's foundation and base is prepared, which may be concrete slab or a framed structural deck that can be covered with wooden boards, insulated boards or other decking materials, which optionally can be covered with concrete spray material and troweled. The walls of the building or housing structure are provided as frame **10** sections in accordance with the present system and method are typically assembled flat on the ground using screw drill guns that fasten the frames to headers, sills or other reinforcing pieces. When the wall's exposed side is completed in assembly, it is tilled up, screw drilling the frame **10** sections together until completed and the wall put into place. By repeating this process, each wall of the building or housing unit is assembled and may comprise one or more sections of frame **10**. The workers only need to match the markings on the end of the frame sections and other components to correctly assemble the walls or other structures. After the walls are standing, a header assembly, if needed, can be installed to give stability to the wall panels, and the roof trusses can be placed. Roof trusses are assembled in the same manner as the wall units.

**[0028]** The exterior sides **101** of frames **10** are then covered with the wallboard **11**, preferably with good insulating properties, which is affixed to the frame **10** sections by fasteners **30** or other suitable means. Grid **12** may be then fastened to the wallboard **11** which helps with the application of concrete layer **13** and adds tensile strength to the concrete layer **13**. The concrete layer **13**, in some embodiments, is applied by a spraying application and depicted in FIG. **5**. Multiple thin layers of concrete may be applied until the concrete layer **13** has a suitable thickness, for example 2-3 inches. It is desirable for the grid **12** to be located substantially in the middle of the concrete layer and thus the grid **12** is spaced apart from the wallboard **12** and the final outer wall surface of the concrete layer **13**. Once the concrete layer **13** has cured, the housing structure is formed and finishing can take place. Roof frame **10** sections may be constructed in a similar manner but would typically be covered with a roofing material of choice as wallboard **11**, preferably a material that provides good water resistance and good insulation.

**[0029]** The exterior wallboards **11** may comprise a variety of building construction materials known in the art. In some embodiments, the wallboard **11** comprises what is known in the art as "blueboard" which is configured to accept and react with the cement layer **13** for optimal adhesion and durability. Other foam-like materials may be utilized as wallboard **11** and such materials may be chemically treated to accept adherence of cement. As is known in the art, "blueboard" is typically a foam-board insulation material comprising polyisocyanurate, extruded polystyrene, expanded polystyrene foam, and combinations thereof. The wallboard **11** material may be selected according to its "R-value" or thermal resistance value and may preferably have an R-value between 4.5 and 5.0, which is typical of blueboard known in the art. It is appreciated that "blueboard" as generally known in the art is of higher quality than typical dry wall or sheet rock, typically having greater strength, insulation, and resistance to the elements. Blueboard is also beneficial because of the treating that it undergoes (often treated with gypsum), which provides the aforementioned enhanced adherence to cement or plaster. While blueboard is somewhat more expensive than the typical non-treated drywall, it has the desired characteristics for the wallboard **11** of the present system and method. It is appreciated, however, that other materials including composite styrofoam, foam and foam-like boards known in the art are contemplated, provided they have improved insulation, strength, and plaster/cement adherence characteristics. One such material is the Georgia Pacific DenseGlass product which is a drywall and fiberglass composite.

**[0030]** The application of the concrete layer **13** is quickest and most efficient when sprayed, as shown in FIG. **5**. The concrete mix can be customized with additives to get better adherence to the wall board and can be adjusted as to drying time. Further use of elastomeric additives to the concrete reduces cracking of the concrete surface, and helps in creating a watertight envelope. The thickness of the concrete is a function of the strength desired and for commercial type installation it may be increased.

**[0031]** As mentioned above, interior walls can be covered with typical drywall materials and if additional insulation is desired it can accomplished by using blown in insulation, batting, or board type, installed on the interior side **102** of the frame **10**. The exterior concrete, after curing, can be painted to provide the desired appearance. When constructing multiple identical units, the product can be quickly assembled and made ready for use. The method of construction of the units consists of fabricating the frames, marking the frames, assembling the frames in the walls, trusses and assemblies, covering the exterior walls with a wall board, adding a lattice or wire mesh to the exterior surface of the wall board if desired; spraying the exterior with wall board with the desired amount of cement; allowing the concrete to cure. By following these steps a very strong structure for an affordable quickly built housing or commercial units is obtained.

**[0032]** The combined concrete, with board and frame structure creates a composite structure with unexpected strong properties to resist earthquake, hurricane and other disruptive effects. The final product is superior strength for a housing unit that can be quickly and economically constructed with a labor for having minimal skill sets. There are numerous variations that can be employed with respect to the materials selected in order to meet the local conditions and to accommodate the need being addressed.

**[0033]** The instant invention has been shown and described herein in what is considered to be the most practical and preferred embodiments. It is recognized, however, that departures may be made therefrom within the scope of the invention and that obvious modifications will occur to a person skilled in the art.

What is claimed is:

**1**. A composite building construction system, comprising:

a frame, wallboard, and a concrete layer;

wherein said wallboard is attached to an exterior side of said frame; and

wherein said concrete layer is provided on said wallboard.

**2**. The composite building construction system of claim **1**, further comprising a wire grid attached to and spaced apart from said wallboard, said grid providing a support structure for said concrete layer.

**3**. The composite building construction system of claim **1**, wherein said concrete layer has a thickness of 3 inches.

**4**. The composite building construction system of claim **1**, wherein said frame including a plurality of outer framing members and one or more cross members.

**5**. The composite building construction system of claim **4**, wherein said outer framing members and said one or more cross members include one or more apertures for the routing of electrical wires or plumbing.

**6**. The composite building construction system of claim **5**, wherein said apertures are adapted to receive conduits for protecting said electrical wires and said plumbing.

**7**. The composite building construction system of claim **1** wherein said frame member is prefabricated and coded for assembly.

**8**. The composite building construction system of claim **1**, wherein an interior side of said frame is configured to receive drywall.

**9**. The composite building construction system of claim **1**, wherein insulation is disposed within said frame.

**10**. The composite building construction system of claim **1**, wherein said frame comprises steel.

**11**. The composite building construction system of claim **1**, wherein said wallboard comprises blueboard.

**12**. A method of building construction, comprising:

providing one or more frame sections;

attaching wallboard to an exterior side of said frame sections;

attaching a wire grid to said wallboard such that said wire grid is spaced apart from said wallboard; and

spraying a concrete layer over said wallboard and said wire grid.

**13**. The method of claim **12**, further comprising the step of:

After providing the one or more frame sections and before attaching wallboard to an exterior side of said frame sections, assembling said one or more frame sections to form a housing unit.

**14**. The method of claim **13**, wherein said one or more frame sections are prefabricated and coded according to a building construction plan.

**15**. The method of claim **12**, wherein said frame comprises steel.

**16**. The method of claim **12**, wherein said wallboard comprises blueboard.

**17**. The method of claim **12**, wherein said concrete layer has a thickness of 3 inches.

**18**. The method of claim **12**, wherein an interior side of said frame is configured to receive drywall.

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