

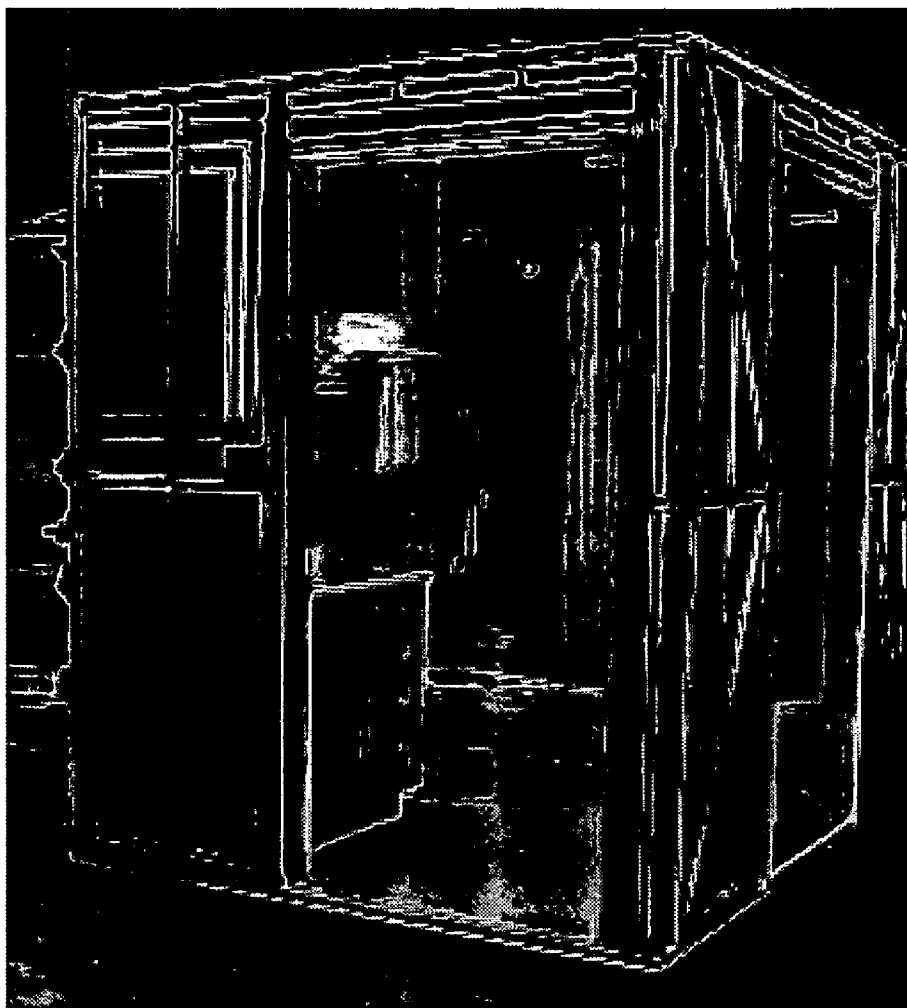


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(19) **United States**(12) **Patent Application Publication**
Barrett et al.(10) **Pub. No.: US 2007/0294954 A1**(43) **Pub. Date: Dec. 27, 2007**(54) **PREFABRICATED BATHROOM ASSEMBLY
AND METHODS OF ITS MANUFACTURE
AND INSTALLATION**(52) **U.S. Cl. 52/36.2**(76) **Inventors:** **Jeffrey L. Barrett**, Concord, MA
(US); **Adam Hedgcock**, Alston,
MA (US)(57) **ABSTRACT**

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A prefabricated bathroom assembly and methods for its manufacture and installation are disclosed. The prefabricated bathroom assembly preferably includes at least some of the same or similar building materials (e.g., stud construction, tile finishing, wallpaper, and floor-mounted toilets) traditionally used for on-site construction, in order to provide maximal aesthetic quality and comfort as well as the ability for a purchaser to customize the design. The bathroom assembly is preferably pre-fabricated substantially in its entirety off-site for delivery to the site in a single piece, and needing only fastening into place and connection to utilities at the site in order to complete the installation. In an embodiment, a prefabricated bathroom with a low-profile floor is provided that complies with applicable provisions of the Americans with Disabilities Act ("ADA"). In another embodiment, Computer Aided Design ("CAD") technology is used in the design of the prefabricated bathroom assembly.

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E04H 1/00 (2006.01)

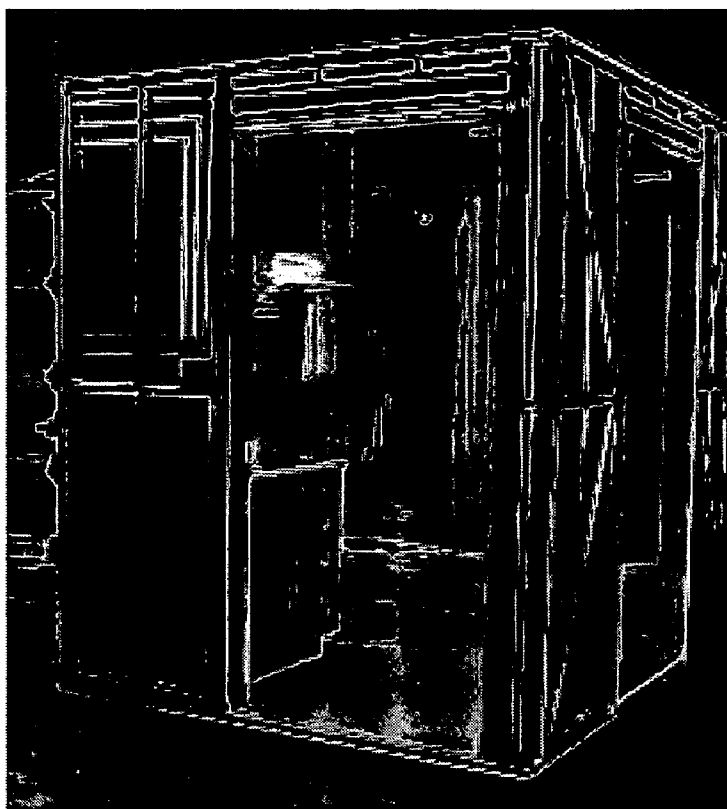


FIG. 1A

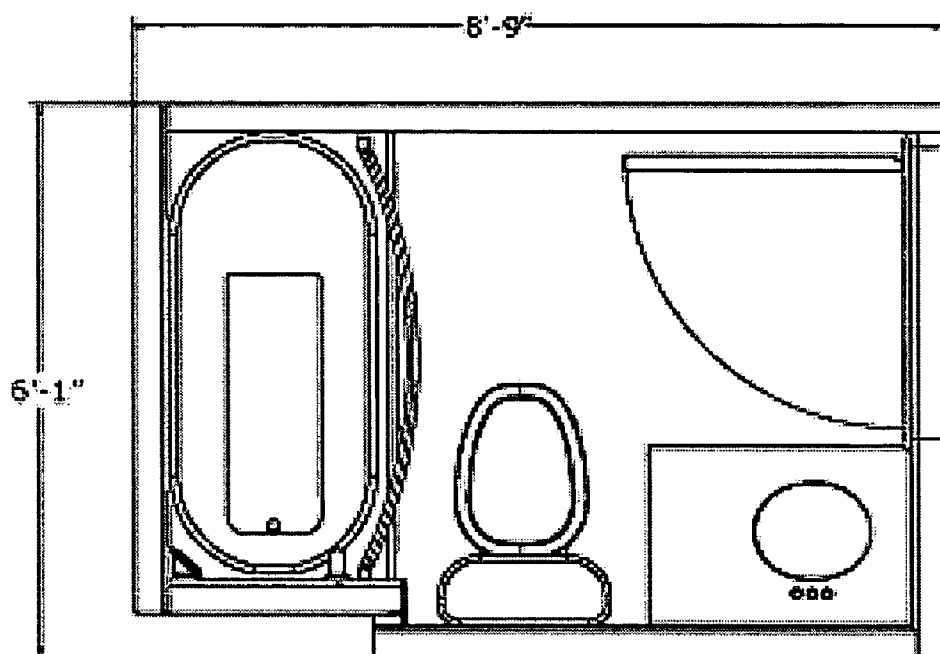


FIG. 1B

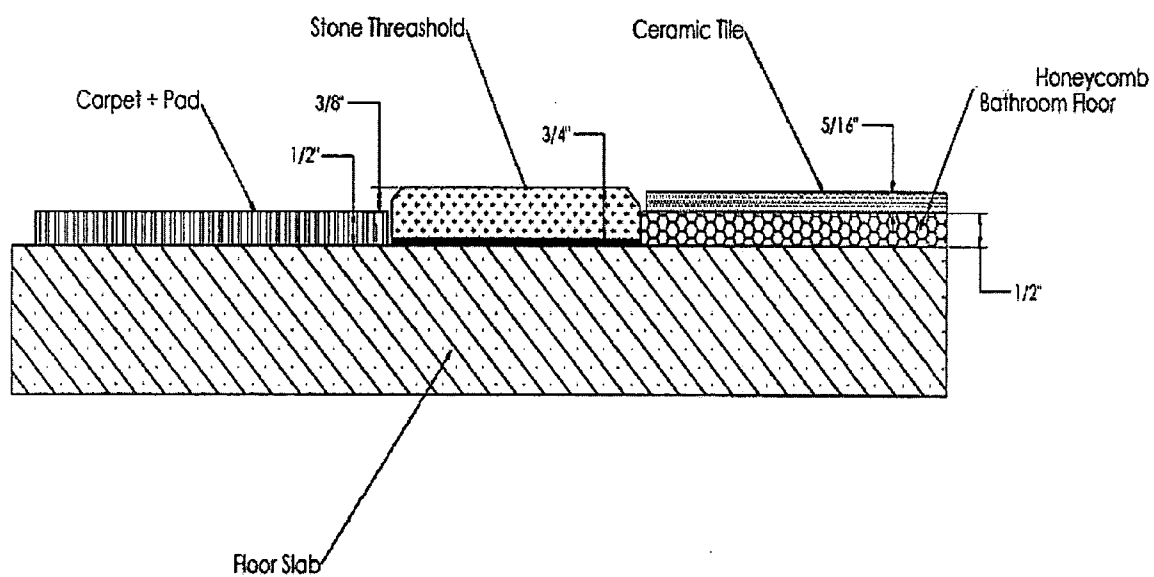


FIG. 2

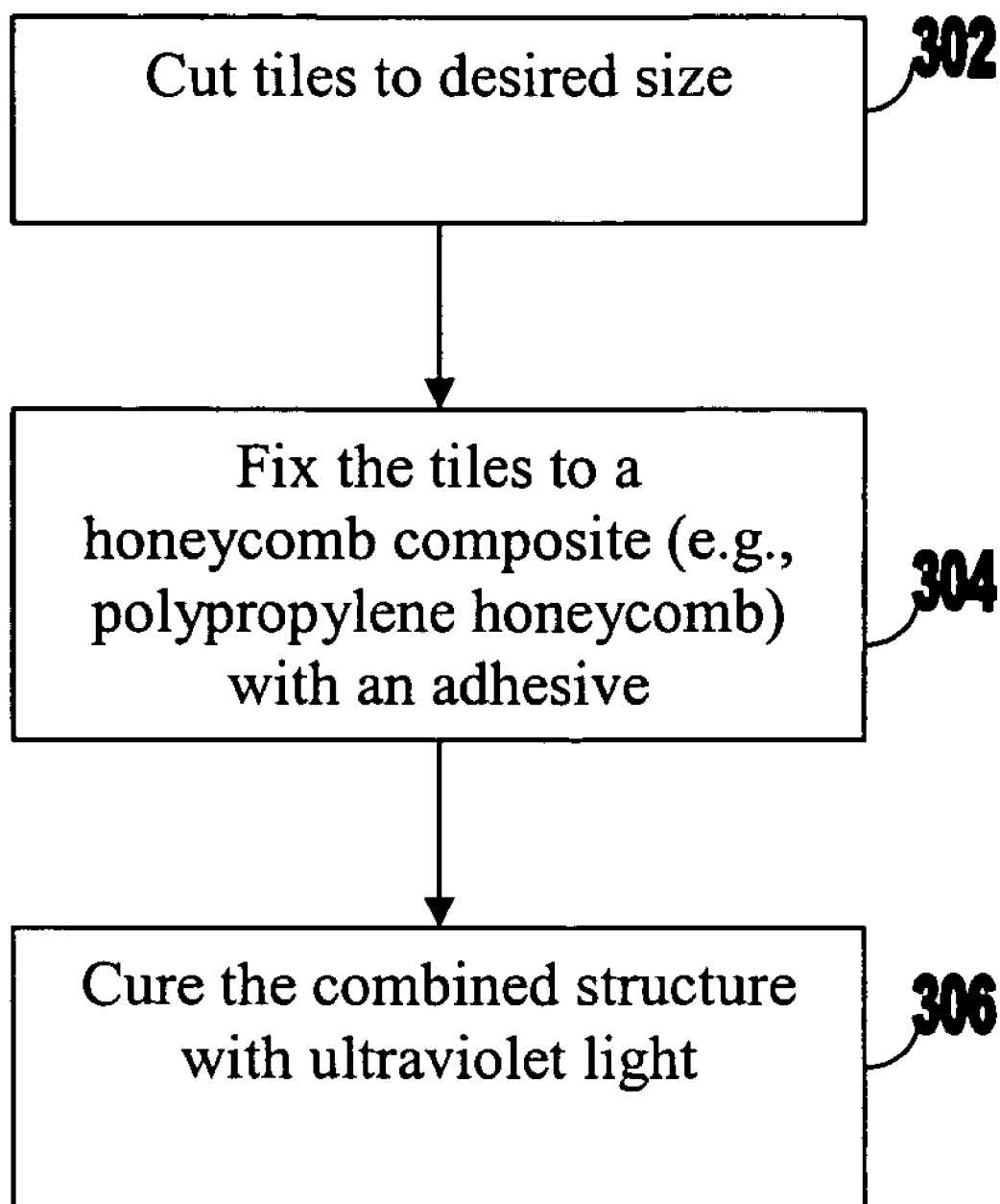


FIG. 3

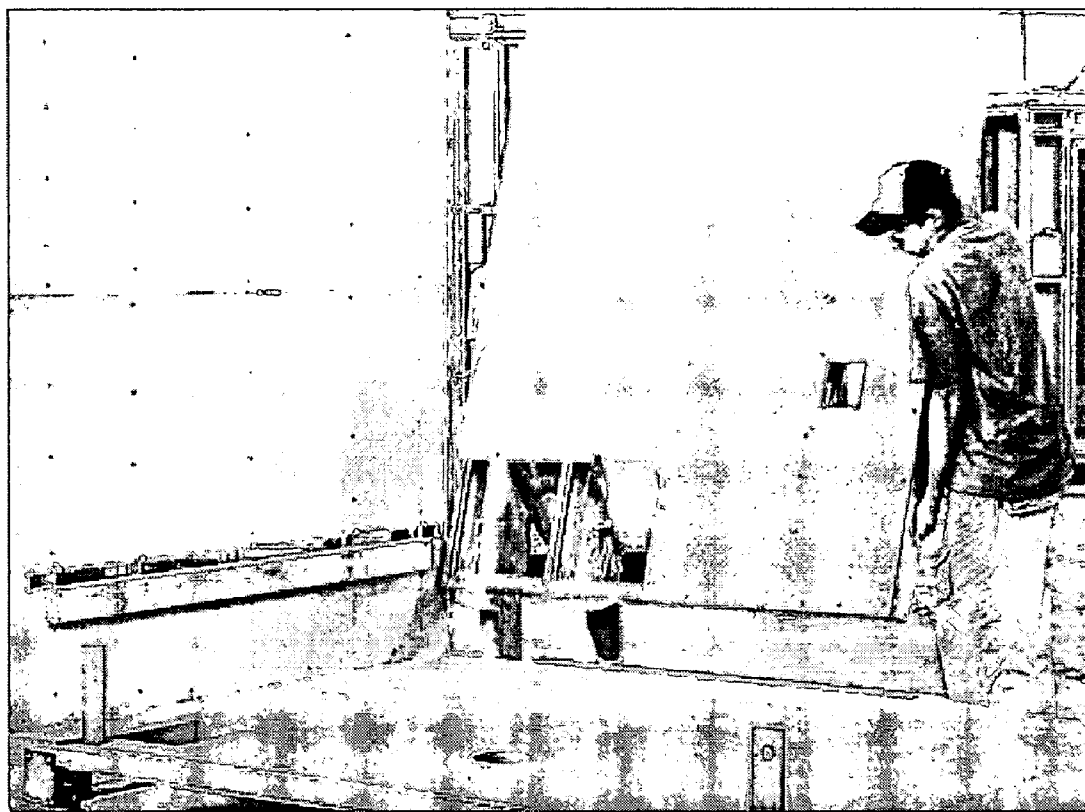


FIG. 4

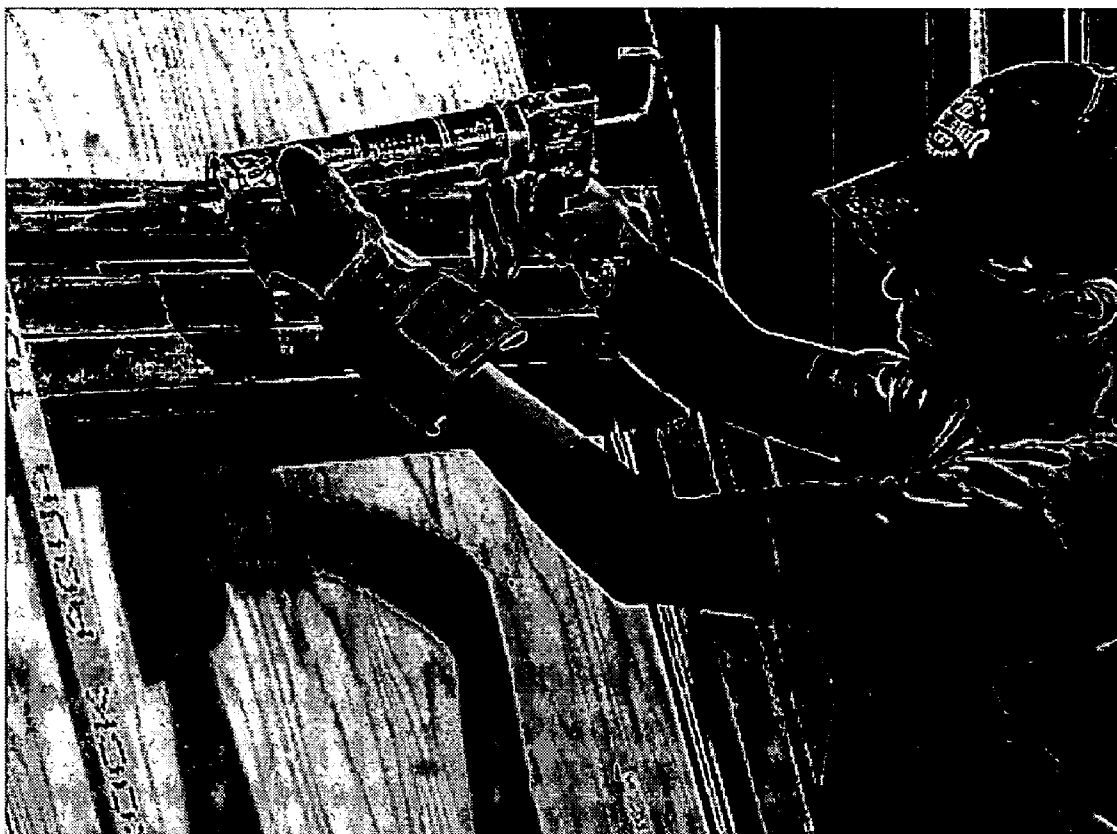


FIG. 5

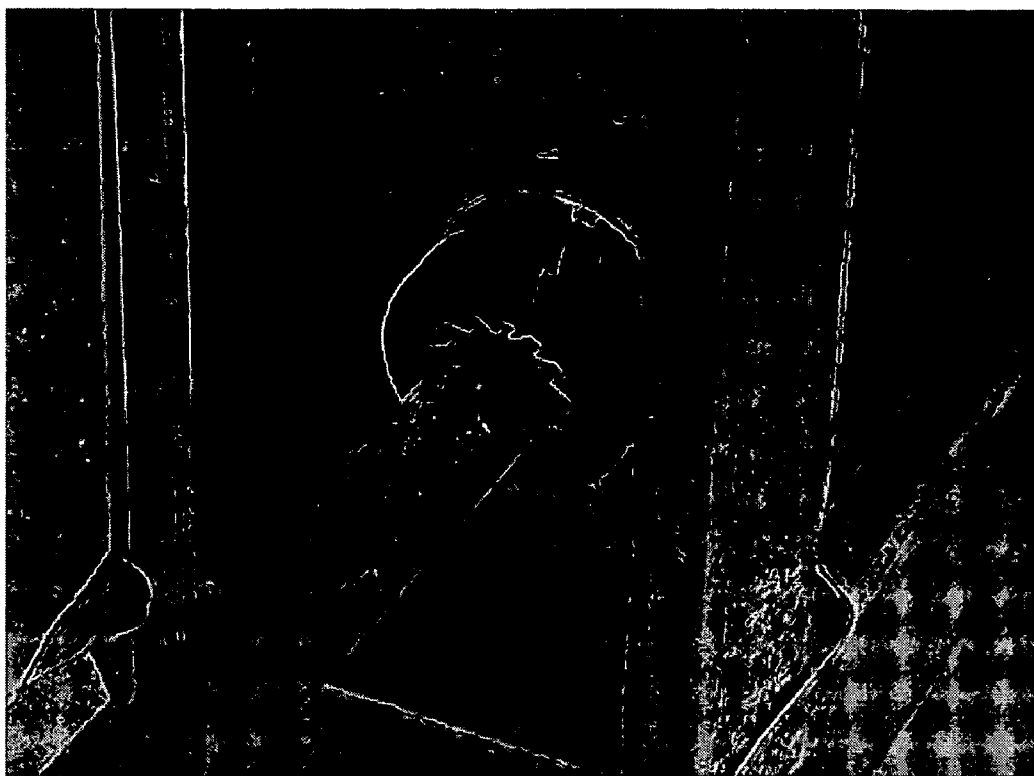


FIG. 6

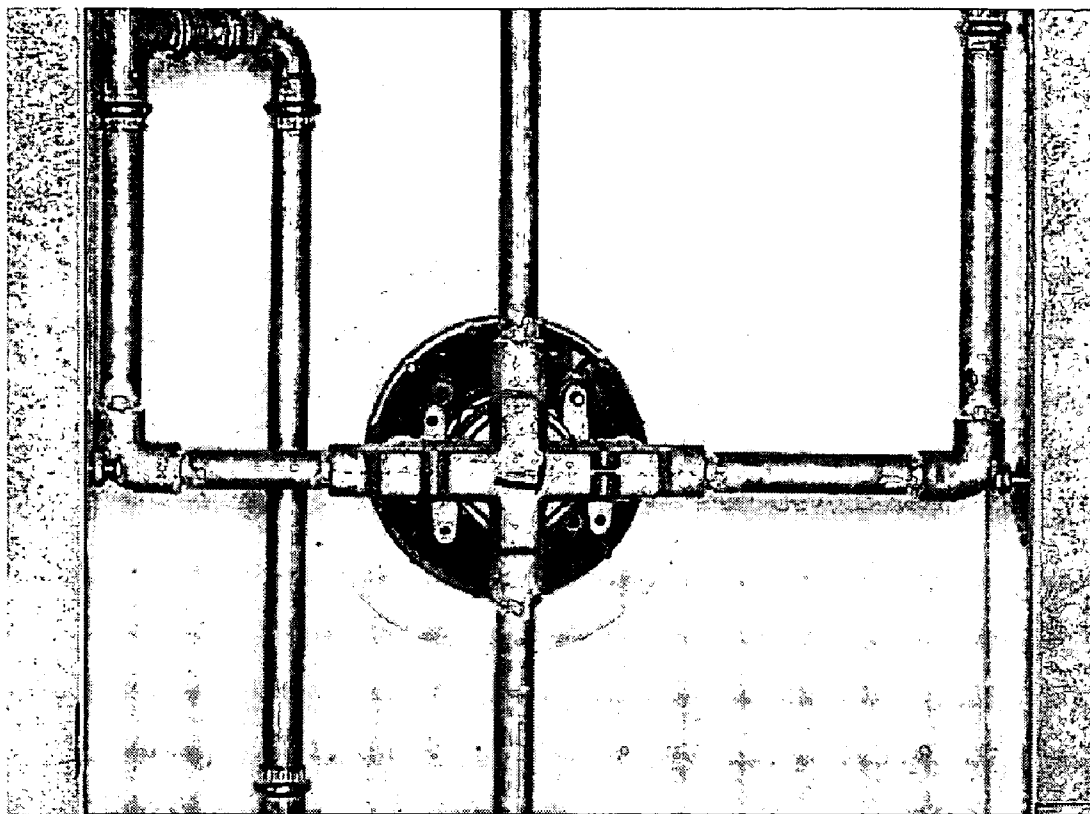


FIG. 7

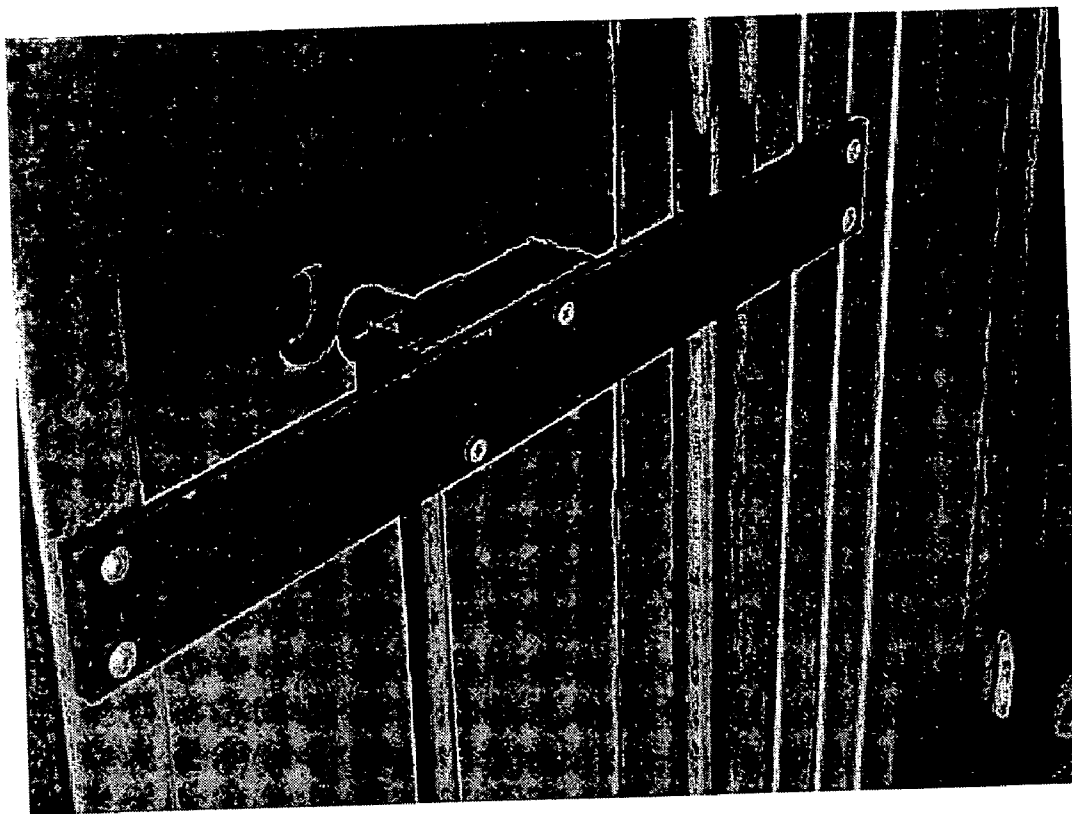


FIG. 8

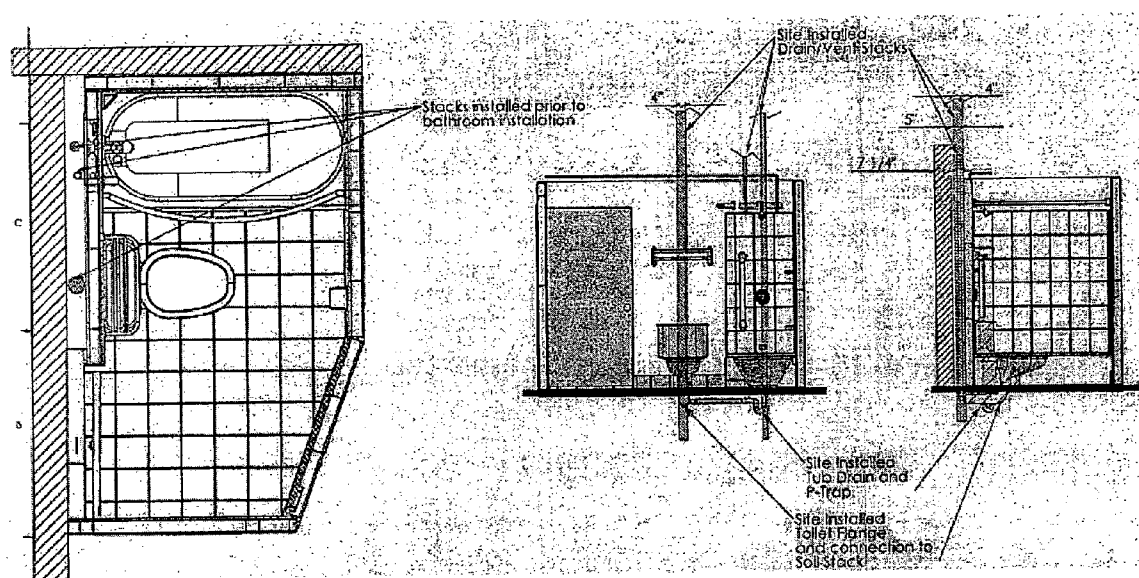


FIG. 9

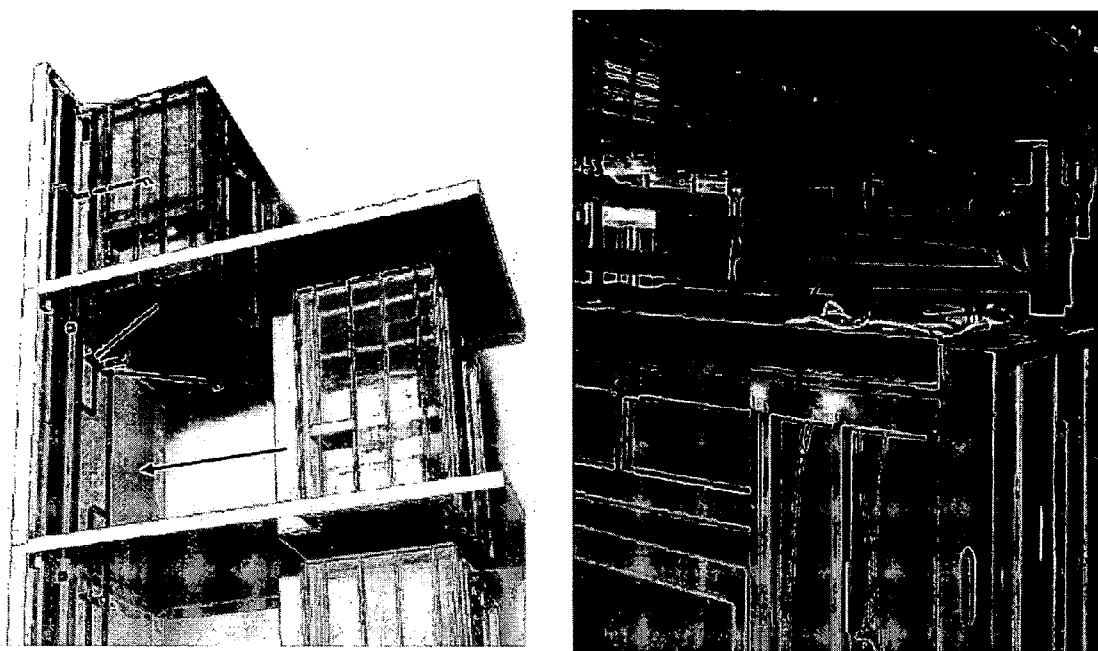


FIG. 10

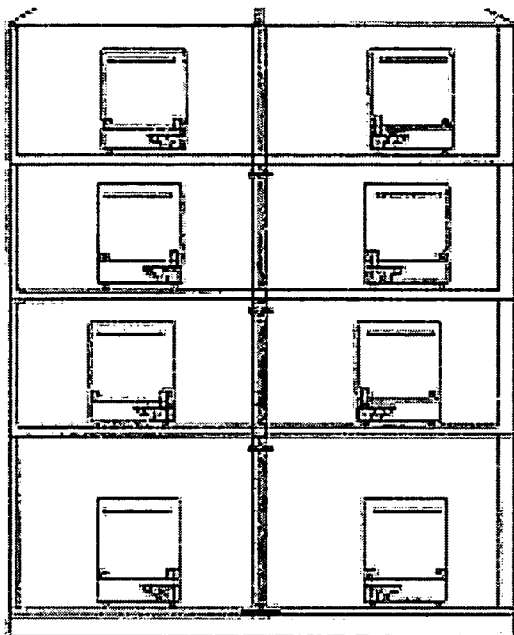


FIG. 11A

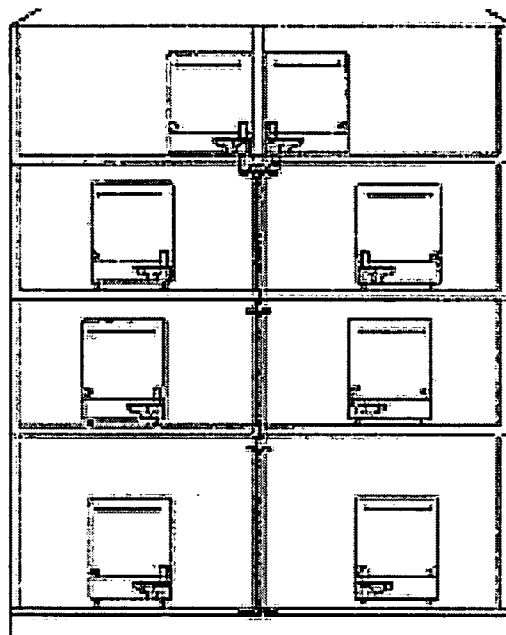


FIG. 11B

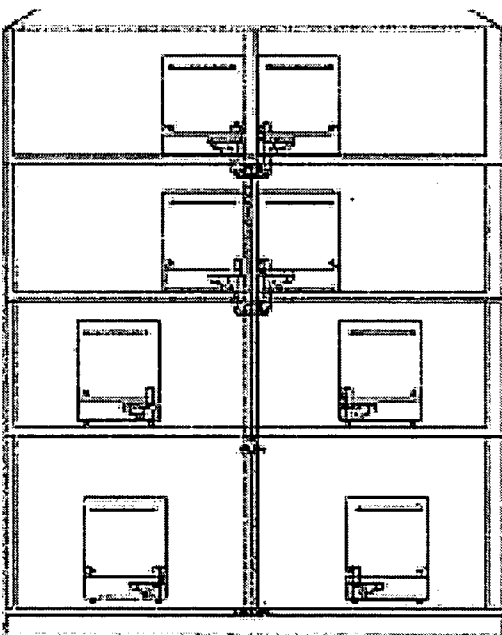


FIG. 11C

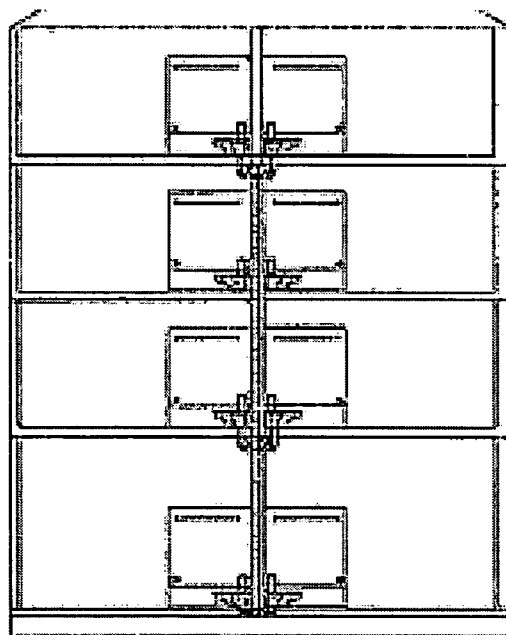


FIG. 11D

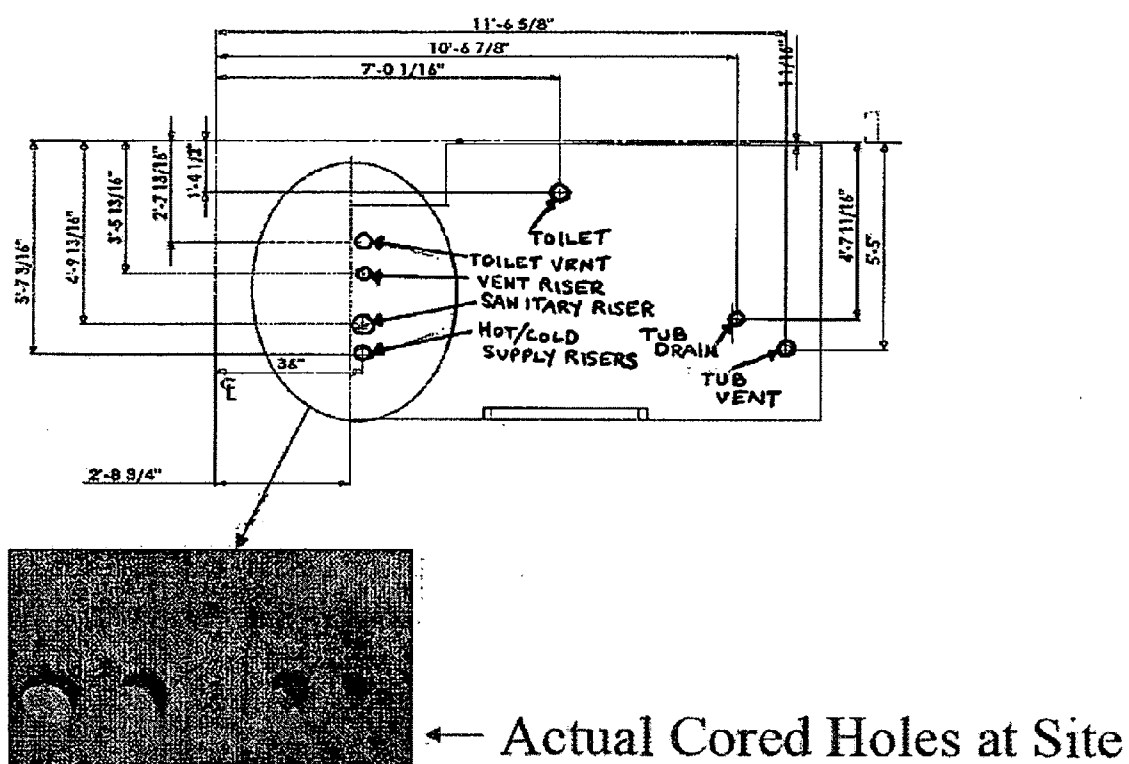


FIG. 12



FIG. 13

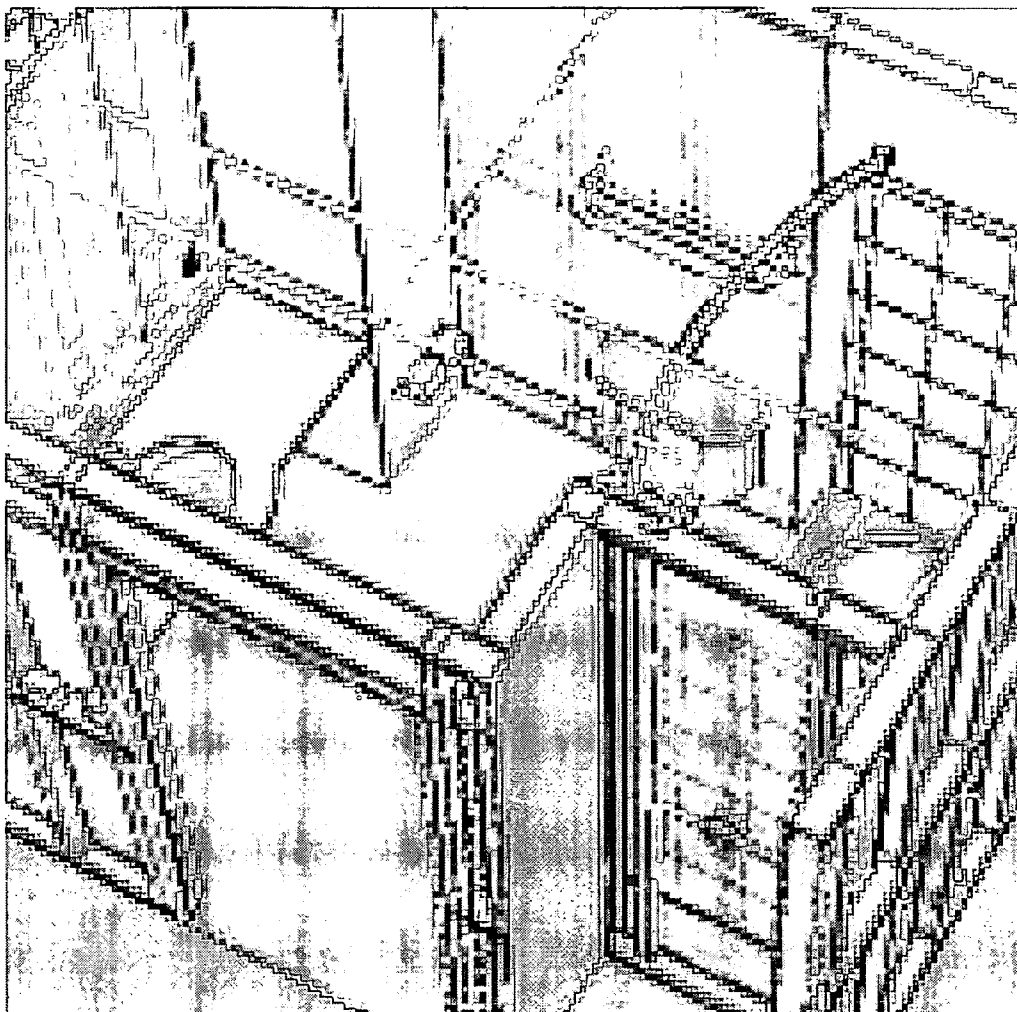


FIG. 14

PREFABRICATED BATHROOM ASSEMBLY AND METHODS OF ITS MANUFACTURE AND INSTALLATION

FIELD OF THE INVENTION

[0001] Embodiments of the present invention relate to a prefabricated bathroom assembly and methods of its manufacture and installation.

BACKGROUND OF THE INVENTION

[0002] Presently, the on-site construction of bathrooms requires various craftsmen such as general contractors, framers, carpenters, electricians, plumbers, plasterers, tilers, and painters to take turns performing their respective tasks. This inevitably results in excessive delay and slow turn-around times for the construction of such bathrooms. This also typically results in high labor costs for bathroom construction due to the large number of parties involved in the construction process.

[0003] For example, the on-site construction of a bathroom in a new residential building typically begins once the underlying structure of the building has been completed. The underlying structure is typically formed of wood/metal and masonry or from concrete. First, the carpenters may move on-site to construct a frame for the bathroom, which may involve the erection of stud walls. Then, the plumbers and electricians may move on-site, one after the other, to run the water and drain pipes and to install the requisite wiring, electrical connections, and junction boxes. After the external walls have been erected, the plasterers/drywallers and tilers may move on-site to construct the internal walls and flooring. Subsequently, the carpenters may return to install doors, windows, cabinets, and other fixtures. The plumbers and electricians may then return to install utility and light fixtures. Lastly, the painters may arrive on-site. Of course, all of these operations must be coordinated and spaced in time to avoid interference on site. Because bathrooms require many trades to work in a confined space, it is common for delays of one trade to impact all the others thereby lengthening construction time.

[0004] Attempts have been made in the prior art to modularize bathroom structures in order to allow for the construction of bathrooms off site. For example, U.S. Pat. No. 5,438,713 relates to a "SEAMLESS BATHROOM MODULE FOR A MARINE VESSEL", in which the floors and walls are formed from a seamless, molded fiberglass structure that can be installed onto the deck of a marine vessel. The floor of this modular bathroom is approximately six inches above the deck, due to a drain assembly that protrudes from the bottom of the module. Another molded fiberglass bathroom is described in U.S. Pat. No. 5,903,937 for a "BATHROOM MODULE ACCESSIBLE TO WHEELED ASSEMBLIES". This bathroom must be installed in a recessed well within the floor to prevent an entrant to the bathroom from encountering a significant step of about 3.5 to 4.5 inches or more, due to the floor support members and drainage trough included in the design.

[0005] Practically, these prior modular bathrooms are not suitable for use in structures, such as residential buildings, that are required to comply with the Americans with Disabilities Act ("ADA"). Particularly, the ADA requires the bathroom floor to be no more than 1/2 inch higher than the floor in the adjacent room so that the bathroom is accessible

to, for example, wheelchairs. Any greater of a transition in floor height from room to room requires the installation of a ramp. It is also unfeasible from a construction perspective to use a modular bathroom that must be placed within a pre-formed recess in the building floor. Such a requirement complicates the construction of the building floor and is not cost effective. For example, for a poured concrete building floor, about 4 inches or more of poured concrete must be added to a concrete slab so to allow the slab to accommodate the recess. Thus, any savings realized from the use of a such a modular bathroom is offset, at least in part, by the increase in material and labor costs involved in forming the required recess. The modular bathrooms noted above also are not readily customizable in terms of size and/or according to aesthetic taste due to their molded fiberglass design.

[0006] In view of the foregoing, it would be desirable to provide an improved prefabricated bathroom assembly and methods of its manufacture and installation, for use in reducing the time required to install bathrooms in comparison to traditional on-site construction.

SUMMARY OF THE INVENTION

[0007] The above and other objects and advantages of the present invention are provided in accordance with the principles of the present invention described herein. Embodiments of the present invention relate to a prefabricated bathroom assembly and methods of its manufacture and installation. In a preferred embodiment, the bathroom assembly includes at least some of the same or similar building materials (e.g., stud construction, tile finishing, wallpaper, floor-mounted toilets, bathtubs, etc.) traditionally used for on-site construction, in order to provide maximal aesthetic quality and comfort as well as the ability for a purchaser to customize the design. The bathroom assembly is preferably pre-fabricated substantially in its entirety off-site for delivery to the site in a single piece, and needing only fastening into place and connection to utilities at the site in order to complete the installation. The prefabricated bathroom assemblies described herein may be particularly suited for installation in residences, commercial buildings, industrial buildings, or any other structures built on land. Nevertheless, it will be understood that embodiments disclosed herein may also be used in marine applications (e.g., state rooms in cruise ships). In an embodiment, the prefabricated bathroom assembly may include a low-profile floor that complies with applicable provisions of the Americans with Disabilities Act ("ADA").

[0008] In an embodiment, a prefabricated bathroom assembly is provided that is preferably substantially entirely prefabricated off site for delivery to a construction site. The prefabricated bathroom includes a frame formed from a plurality of studs. The frame may house at least one (e.g., all) of a toilet, shower, bathtub, and vanity. The prefabricated bathroom assembly also includes a floor fixed to the frame, where the floor includes a floor finishing material that is fixed to a top of a honeycomb composite. For example, the floor may include ceramic tile fixed to polypropylene or aluminum honeycomb with an adhesive such as Bonstone T-2000 tile setting epoxy.

[0009] In another embodiment, a method for manufacturing a floor of a prefabricated bathroom assembly is provided. Generally, tile or other floor finishing material is fixed to a honeycomb composite with an adhesive. Then, the com-

bined structure of tile, adhesive, and honeycomb composite is exposed to ultraviolet light which may, for example, reduce cure time.

[0010] In yet another embodiment, a pre-engineered wall assembly is provided for use in the manufacture of a prefabricated bathroom assembly. A wall assembly is said to be "pre-engineered" when the studs (and optionally at least a portion of the wallboard) thereof are assembled together prior to the being fixed to the floor. The pre-engineered wall assembly may be fixed to the floor material with, for example, an adhesive such as an acrylic adhesive manufactured by LORD, epoxy, construction adhesive or fasteners. The pre-engineered wall-assembly may be manufactured through the use of a computer numerically controlled ("CNC") cutter (e.g., to ensure that the wall panels are cut to the correct size and shape).

[0011] In another embodiment, studs that are pre-formed (e.g., drilled) with holes are provided for use in manufacturing a prefabricated bathroom assembly. The studs may be preformed with (i) fastener holes for making connections with other studs and/or fixtures, and/or (ii) pathways for plumbing and/or electrical connections. The locations of the holes may be determined during the design of the bathroom assembly. In an embodiment, load strength characteristics of the studs are maximized by pre-forming in the studs only the holes that are needed for a particular design of a prefabricated bathroom assembly.

[0012] In still another embodiment, a prefabricated bathroom assembly is provided in which plumbing connections extend through the top and/or bottom of the assembly. For example, a prefabricated bathroom assembly having a floor-mounted toilet (in contrast to a wall mounted toilet) may be provided. Once the prefabricated bathroom assembly arrives at a construction site, the prefabricated bathroom assembly may be connected to site-installed drain and vent stacks, a tub drain, a p-trap, a toilet flange, and/or a soil stack.

[0013] In another embodiment, a "top-down" method is provided for installing in a multi-storied building a plurality of prefabricated bathroom assemblies that have plumbing connections extending through the top and/or bottom thereof. The prefabricated bathroom assembly(ies) at the top of the building are tied in to the building's plumbing utilities first, followed by the assembly(ies) in the floor immediately below, and so on until the last of the prefabricated bathroom assemblies (e.g., on the first floor) have been installed. After installation, the prefabricated bathroom assemblies are substantially vertically aligned.

[0014] In yet another embodiment, a template is provided that models to scale the floor plan (or a portion thereof) of a prefabricated bathroom assembly. The template may be a substantially planar material (e.g., paper, plastic, metal, or other suitable material). The template may include various cutouts (e.g., holes) or other markings that show the location(s) where the hole(s) in the building floor should be formed (e.g., drilled) in order to accommodate the prefabricated bathroom assembly. The template may be delivered to the construction site well in advance of the arrival of the prefabricated bathroom assembly, such as shortly after the design of the prefabricated bathroom assembly is finalized but before the completion of the assembly.

[0015] In another embodiment, a prefabricated bathroom assembly is fitted with a caster system that facilitates transportation of the bathroom assembly and final placement of the bathroom assembly at the construction site.

[0016] In another embodiment, a prefabricated bathroom assembly is designed, at least in part, with Computer Aided Design ("CAD") technology. CAD can be used to design a prefabricated bathroom assembly down to even the smallest details, and may be useful for customizing the design for, for example, a particular living space and/or size tile(s) selected by a customer. In one embodiment, CAD design is used to map the placement of plumbing, electrical components (e.g., wires or conduits), stud dimensions and connections, and/or other fixtures and connections. Such a mapping may be used to determine the exact cutting of wall panel materials such as gypsum board. In another embodiment, CAD design is used to map the layout of tiles on the floor and/or wall(s) of the prefabricated bathroom assembly. At least a portion of the CAD design may be automated. For example, one or more customized scripts may be created for automatically designing the framing layout for wall panels based on input(s) representing the dimensions of the finished wall and/or for automatically mapping placement of the floor tiles based on inputs indicative of the floor dimensions, tile size, toilet placement, and/or tub placement. A library of plumbing and electrical fixtures may be provided that can be inserted into any design, thereby reducing design time.

[0017] Other features and advantages of embodiments of the present invention will be apparent from the detailed description, drawings, and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] For a better understanding of the present invention, reference is made to the following description, taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

[0019] FIGS. 1A and 1B show a prefabricated bathroom assembly and corresponding floor plan in accordance with an embodiment of the present invention;

[0020] FIG. 2 is a cross-sectional diagram of a low-profile floor of a prefabricated bathroom assembly in accordance with an embodiment of the present invention;

[0021] FIG. 3 is a flowchart of illustrative stages involved in manufacturing a floor of a prefabricated bathroom assembly in accordance with an embodiment of the present invention;

[0022] FIG. 4 shows a process for manufacturing a prefabricated bathroom assembly, including the stage of using an adhesive to fix a pre-engineered wall assembly to a floor material, in accordance with an embodiment of the present invention;

[0023] FIG. 5 shows a process for manufacturing a pre-engineered wall assembly, including using an adhesive (and preferably other fasteners such as screws) to fix wallboard to stud(s), in accordance with an embodiment of the present invention;

[0024] FIGS. 6-8 show uses and applications of steel studs in the manufacture of prefabricated bathroom assemblies in accordance with various embodiments of the present invention;

[0025] FIGS. 9-11D show a prefabricated bathroom assembly and top-down method of its installation in a multi-storied building in accordance with an embodiment of the present invention;

[0026] FIG. 12 shows an example of a template for use in pre-forming holes in a building floor for receiving plumbing

connections for a prefabricated bathroom assembly in accordance with an embodiment of the present invention;

[0027] FIG. 13 shows a prefabricated bathroom assembly fitted with a caster system that facilitates transportation and final placement of the bathroom assembly in accordance with an embodiment of the present invention; and

[0028] FIG. 14 shows a view of a CAD-designed prefabricated bathroom assembly in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0029] FIG. 1A shows a prefabricated bathroom assembly in accordance with an embodiment of the present invention. The prefabricated bathroom assembly may be built in compliance with the floor plan shown in FIG. 1B and/or additional instructions such as information or customer preferences regarding the positioning of electrical connections and plumbing, design specifications (e.g., choices of fixtures and/or tiles), and any other suitable instructions. The prefabricated bathroom assembly may be framed with steel studs and finished with materials traditionally used in the on-site construction of residential bathrooms (e.g., ceramic tiles, vanities, wall paper, paint, etc.). Additionally, the prefabricated residential bathroom assembly may include all plumbing and electrical components necessary for hook up to utilities at the construction site, and may require only fastening into place and connection to the utilities at the site in order to complete the installation. Such a sturdy construction and aesthetic finish provide the look and feel of a bathroom that results from on-site construction, without the time delays and costs associated therewith. For example, the present inventors have determined that a minimal crew (e.g., including about 5 members) can install more than 90 of such prefabricated bathrooms within a new, multi-storied building in about 4 days, of course provided that such bathrooms are hoisted into place by a crane or other apparatus. Additional details regarding the design, manufacture, and installation of prefabricated bathroom assemblies in accordance with embodiments of the present invention are described below.

[0030] FIG. 2 is a cross-sectional diagram of a low-profile floor of a prefabricated bathroom assembly in accordance with an embodiment of the present invention. This low-profile design renders the prefabricated bathroom assembly particularly suitable for use in structures that are required to comply with the Americans with Disabilities Act. As shown, both the floor of the prefabricated bathroom and the floor of an adjacent room rest on the same concrete slab, which slab is preferably substantially planar across the room-to-room transition. In other words, in a preferred embodiment, the concrete slab does not include a recess for receiving the prefabricated bathroom assembly. The floor of the prefabricated bathroom assembly preferably includes a composite honeycomb (e.g., a single, continuous piece of composite honeycomb across the entire floor of the prefabricated bathroom) that may rest directly on top of the concrete slab. The honeycomb (e.g., manufactured by NIDA-CORE) may be extruded to a required thickness (e.g., between about 0.5 and 1.5 inches) and then laminated with a fiberglass skin to produce a single panel that matches the floor plan of the bathroom assembly. The composite honeycomb sheet may be fixed to the concrete slab with a cementitious slurry or urethane based adhesive typically used in general construc-

tion. The present inventors have determined that composite honeycomb has sufficient structural properties to support a prefabricated bathroom assembly, such as the assembly shown in FIG. 1A, during transportation to a construction site and after installation of the prefabricated assembly. In a preferred embodiment, the composite honeycomb includes a polypropylene honeycomb floor, which is waterproof and will not rust. In another embodiment, the composite honeycomb includes aluminum honeycomb. However, aluminum honeycomb may be a less desirable choice due to its propensity to rust over time. Ceramic tiling or other tiling or building material may be fixed on top of the honeycomb composite in order to finish the floor of the prefabricated bathroom assembly. A method for affixing tile to a honeycomb composite is described in greater detail below in connection with FIG. 3. The floor of the adjacent room may be finished with a carpet and pad, tiles, wood flooring, and/or any other suitable flooring material.

[0031] In the example shown in FIG. 2, the floor adjacent to the prefabricated bathroom floor is finished with a carpet and pad and has a height of about $\frac{1}{2}$ inch. Thus, in order to comply with the ADA, the total height of the prefabricated bathroom floor must be less than or equal to 1 inch (i.e., no more than $\frac{1}{2}$ inch higher than the adjacent floor). As shown, the floor of the prefabricated bathroom assembly has a total height of about $\frac{13}{16}$ inches, including $\frac{1}{2}$ inch for the honeycomb composite and $\frac{5}{16}$ inch for ceramic tiling. Thus, compliance with this provision of the ADA is achieved. A stone threshold that has beveled edges and a height of $\frac{3}{4}$ inch is also provided in the example of FIG. 2, which eases the transition from the prefabricated bathroom floor to the adjacent floor, and vice versa. A beveled edge (or edges, as shown in FIG. 2) is required by the ADA for transitions in height from room to room of between $\frac{1}{4}$ inch and $\frac{1}{2}$ inch. No beveled edge is required a transition in height from room to room of less than (or equal to) $\frac{1}{4}$ inch.

[0032] The example shown in FIG. 2 is only illustrative. In other scenarios, other materials and/or heights for (i) the flooring that is fixed to the top of the honeycomb composite and/or (ii) the adjacent floor may be present depending on, for example, customer preference. Alternatively or additionally, the height of the honeycomb composite can be adjusted. For example, based on changes to the heights of (i) and (ii) noted above, the height of the honeycomb composite can be increased to greater than $\frac{1}{2}$ inch (e.g., up to 1.5 inches) as necessary to achieve a transition in height from room to room of less than or equal to $\frac{1}{2}$ inch. A single sheet of honeycomb composite having the desired height may be used. Other embodiments are of course possible and are fully contemplated as being within the scope of the present invention. For example, two honeycomb sheets could be used in combination with another material, such as concrete (e.g., a concrete layer or plywood sandwiched between the sheets of honeycomb composite), to form the foundation upon which the material that finishes the prefabricated bathroom floor is fixed.

[0033] FIG. 3 shows a method for manufacturing a floor of a prefabricated bathroom assembly in accordance with an embodiment of the present invention. At stage 302, tiles (e.g., ceramic or marble tiles) are cut to specification by automated equipment (e.g., a computer numerically controlled ("CNC") machine) and/or manually. For example, stage 302 may involve the use of a computer-controlled cutter to cut the tiles that will surround a tub and/or a toilet.

This may ensure a proper fit and reproducibility for modular construction, in a way that cannot be matched by traditional on-site construction. The tile cutting performed at stage **302** may be based, at least in part, on instructions that result from CAD design, which is described in greater detail below. In other embodiments, a floor material other than tiles may be prepared at stage **302**. At stage **304**, the tiles may be fixed to the honeycomb composite through the use of an adhesive such as, for example, Bonstone T-2000 tile setting epoxy adhesive or other adhesive. At stage **306**, the combined structure of honeycomb composite, adhesive, and tile may be cured with ultraviolet light (e.g., Infratech, High Intensity Heat Curing Lamp, 120V SRU-1615). Typically, the curing of tiles takes 24 hours or more. However, the present inventors have determined that the use of ultraviolet light can reduce curing time to about 1 hour. This exposure of the combined structure to ultraviolet light may involve placing the structure in an ultraviolet oven for 1 hour.

[0034] Additional features of various embodiments of the present invention will now be described. The following features may be used alone or in combination with the features described above regarding a prefabricated bathroom assembly with a low-profile floor. For example, in one embodiment, all (or any subset) of the features described in this application may be used in the construction and/or installation of a prefabricated bathroom assembly. In another embodiment, a no-floor prefabricated bathroom assembly may be provided that includes any or all of the features described below and that, in addition to requiring connection to utilities at a construction site, requires the on-site installation of a floor (e.g., tile).

[0035] FIG. 4 shows an embodiment in which pre-engineered wall assembly(ies) are fixed to a floor material (e.g., one or more honeycomb composite sheets) during the manufacture of a prefabricated bathroom assembly. A wall assembly is said to be “pre-engineered” when the studs (and optionally at least a portion of the wallboard) thereof are assembled together prior to the being fixed to the floor. For example, the studs and/or wallboard (e.g., plywood, plasterboard, concrete wonderboard, or other planar wall finishing material) may be substantially entirely pre-assembled through the use of a jig in order to ensure that the resulting wall assembly is square. Wallboard for the pre-engineered wall-assembly may be cut with a CNC cutter to ensure that the wallboard is cut to the correct size and shape. In one embodiment, the pre-engineered wall assemblies are fixed to the floor material before the floor material is tiled (e.g., tiled using the method of FIG. 3). Alternatively, the pre-engineered wall assemblies can be fixed to the floor material (e.g., to edge(s) of the floor material) after at least a portion of the floor material has been tiled. In a preferred embodiment, the pre-engineered wall assemblies are fixed to the floor material with an adhesive, such as an acrylic adhesive manufactured by LORD (e.g., LORD 406/17 Acrylic Adhesive) or other suitable adhesive and/or fasteners. The use of an adhesive to fix the wall assembly(ies) to the floor material may be particularly beneficial when the floor material is so thin (e.g., about 1/2 inch or less) that the use of fasteners such as screws could compromise its structural integrity. Alternatively or additionally, the pre-engineered wall assemblies may be fixed to the floor material with screws, nails, and/or other fasteners.

[0036] FIG. 5 shows an embodiment in which a pre-engineered wall assembly is manufactured by fixing wall-

board to studs with an adhesive (e.g., OSI Sealants Inc PL400 Adhesive). Other fasteners such as screws are also preferably used to fix the wallboard to the studs. The use of both an adhesive and another fastener to fix the wallboard to the studs strengthens the resulting prefabricated bathroom assembly for transportation. The adhesive also prevents the fasteners from “backing out” of the studs and protruding through the wallboard.

[0037] In an embodiment, the prefabricated bathroom assembly is manufactured with studs (e.g., steel studs) that are pre-formed (e.g., pre-drilled) with (i) fastener holes for making connections with other studs and/or fixtures, and/or (ii) pathways for plumbing and/or electrical connections. The locations of the holes may be determined by a computer during a design process that involves, for example, CAD. In an embodiment, load strength characteristics of the studs are maximized by pre-punching in the studs only the holes that are needed for a particular design of a prefabricated bathroom assembly. For example, FIG. 6 shows an embodiment in which hole(s) are pre-formed to allow for the passage of plumbing line(s). As another example, FIG. 7 shows an embodiment in which hole(s) are pre-formed in the studs for fastening plumbing lines to the studs (e.g., to prevent or reduce the rattling of water pipes). Still another example, FIG. 8 shows an embodiment in which hole(s) are pre-formed in the studs for attaching a brace for a shower head and/or a tub spout to the studs. The embodiment of FIG. 8 may be particularly useful for prefabricated bathroom assemblies destined for hotels, as hotel customers may be particularly tough on plumbing fixtures. In other embodiments, fastener holes and/or pathways may be formed in the studs while or after the studs are being connected together.

[0038] FIG. 9 shows an embodiment of a prefabricated bathroom assembly in which plumbing connections extend through the top and/or bottom of the assembly. For example, a prefabricated bathroom assembly having a floor-mounted toilet (in contrast to a wall mounted toilet) may be delivered to a construction site. Once the prefabricated bathroom assembly arrives at a construction site, the prefabricated bathroom assembly may be connected to site-installed drain and vent stacks, a tub drain, a p-trap, a toilet flange, and/or a soil stack.

[0039] FIGS. 10-11D show a “top-down” method for installing a plurality of prefabricated bathroom assemblies (e.g., of the type shown in FIG. 9) in a multi-storied building in accordance with an embodiment of the present invention. As shown, the prefabricated bathroom assembly(ies) at the top of the building are tied in to the building’s plumbing utilities first, followed by the assembly(ies) in the floor immediately below, and so on until the last of the prefabricated bathroom assemblies (e.g., on the first floor) have been installed. After installation, the prefabricated bathroom assemblies are substantially vertically aligned.

[0040] FIG. 10 also shows that various holes may be pre-drilled in each building floor (e.g., a poured concrete slab or wood deck) prior to the installation of the prefabricated bathroom assemblies. In an embodiment, this pre-drilling may be accomplished through the use of a template, which template may be delivered (or available for delivery) to the construction site well in advance of the arrival of the prefabricated bathroom assembly(ies) (e.g., shortly after the design of the prefabricated bathroom assembly is finalized but before the completion of the assembly). The template may be a substantially planar material (e.g., paper, plastic,

metal, or other suitable material) that models the floor plan (or a portion thereof) of a prefabricated bathroom assembly to scale. The template may include various cutouts (e.g., holes) or other markings that show the location(s) where the hole(s) in the building floor should be drilled in order to accommodate the prefabricated bathroom assembly. Following proper placement of the template on the building floor (or a marking on the floor of the hole locations as indicated in the template), the holes can be drilled (or otherwise formed) in the building floor in the locations of the cut-outs or other markings. An example of such a template is shown in FIG. 12. It will be understood that the locations of the holes in the template of FIG. 12 are only illustrative and that such locations may vary from one design to another. The use of such a template is equally applicable to the installation of a single prefabricated bathroom assembly.

[0041] FIG. 13 shows a prefabricated bathroom assembly fitted with a caster system that facilitates transportation (rolling) of the bathroom assembly and final placement of the bathroom assembly at a construction site, in accordance with an embodiment of the present invention. Typically, the prefabricated bathroom assembly is rolled from an off-site manufacturing plant onto a truck and, upon arrival at the construction site, from the truck onto a lifting basket (for use when a crane will lift the basket to an upper floor of a building) and from the lifting basket into proper position within the building. The caster system combines a roller mechanism with a vertical lift. The caster system may attach to the exterior framing of the bathroom assembly. Once the bathroom assembly has been rolled into place, the vertical lift allows the bathroom to be lowered in the precise location.

[0042] FIG. 14 shows a view of a CAD-designed prefabricated bathroom assembly in accordance with an embodiment of the present invention. As shown, CAD can be used to design a prefabricated bathroom assembly down to even the smallest details. In one embodiment, CAD design is used to map the placement of plumbing, electrical components (e.g., wires or conduits), stud dimensions and connections, and/or other fixtures and connections. Such a mapping may be used to determine the exact cutting of wall panel materials such as gypsum board. The CAD layout is transferred to a CNC cutter which cuts the panels to the correct size and shape. In another embodiment, CAD design is used to map the layout of tiles on the floor and/or wall(s) of the prefabricated bathroom assembly. Such a mapping may efficiently plan (e.g., minimize) the number and dimensions of the cuts that are required in the tiles, which cuts may be performed, for example, automatically by a computer-controlled cutter. The CAD design may be accomplished through the use of any suitable CAD computing package, such as the CAD software made commercially readily available by SolidWorks Corporation. At least a portion of the CAD design may be automated, in that one or more customized scripts may be created for, for example, automatically designing the framing layout for wall panels upon input of, for example, the dimensions of the finished wall. Alternatively or additionally, the mapping of floor tiles may be automated upon, for example, one or more inputs indicative of the floor dimensions, toilet placement, and/or tub placement. A

library of plumbing and electrical fixtures may be provided that can be inserted into any design, thereby reducing design time.

Other Embodiments

[0043] Thus it is seen that a prefabricated bathroom assembly and methods for its manufacture and installation are provided. Although particular embodiments have been disclosed herein in detail, this has been done by way of example for purposes of illustration only, and is not intended to be limiting with respect to the scope of the appended claims, which follow. In particular, it is contemplated by the inventors that various substitutions, alterations, and modifications may be made without departing from the spirit and scope of the invention as defined by the claims. Other aspects, advantages, and modifications are considered to be within the scope of the following claims. The claims presented are representative of the inventions disclosed herein. Other, unclaimed inventions are also contemplated. The inventors reserve the right to pursue such inventions in later claims.

What is claimed is:

1. A prefabricated bathroom assembly, comprising:
 - a frame comprising a plurality of studs, said frame housing at least one of a toilet, shower, bathtub, and vanity; and
 - a floor fixed to said frame, said floor comprising a honeycomb composite and a floor finishing material, said floor finishing material fixed to a top of said honeycomb composite,
 wherein said prefabricated bathroom assembly is substantially entirely fabricated off site for delivery to a construction site.
2. The prefabricated bathroom assembly of claim 1 wherein said honeycomb composite comprises polypropylene honeycomb.
3. The prefabricated bathroom assembly of claim 2 wherein said polypropylene honeycomb has a height of about 0.5 to 1.5 inches.
4. The prefabricated bathroom assembly of claim 2 wherein said floor finishing material comprises tile.
5. The prefabricated bathroom assembly of claim 4 further comprising an adhesive for fixing said tile to said polypropylene honeycomb.
6. The prefabricated bathroom assembly of claim 1 wherein said floor comprises a height no more than ½ inch higher than a floor in an adjacent room.
7. The prefabricated bathroom assembly of claim 1 wherein at least one of said studs is pre-formed with at least one hole for making a connection to another stud or fixture or for forming a pathway for a plumbing or electrical line.
8. The prefabricated bathroom assembly of claim 1 wherein said at least one of said studs only includes pre-drilled hole(s) that are actually used in said prefabricated bathroom assembly once said prefabricated bathroom assembly is assembled, installed, or both.
9. The prefabricated bathroom assembly of claim 1 wherein said frame comprises at least one pre-engineered wall assembly that is fixed to said floor with an adhesive or fastener.
10. The prefabricated bathroom assembly of claim 1 wherein said floor comprises at least one cutout for plumbing, said at least one cutout selected from the group consisting of a cutout for a plumbing line connected to toilet, a

cutout for a plumbing line connected to a vanity, and a cutout for a plumbing line connected to a shower.

11. The prefabricated bathroom assembly of claim **1** further comprising an integral roller mechanism and mechanical lift for facilitating transportation to and final placement of said prefabricated bathroom assembly at said construction site.

12. A method of manufacturing a bathroom assembly, said method comprising:

substantially entirely fabricating said bathroom assembly off site relative to a construction site for delivery to said construction site, said substantially entirely fabricating said bathroom assembly comprising:

assembling a frame comprising a plurality of studs, said frame for housing at least one of a toilet, shower, bathtub, and vanity; and

fixing a floor to said frame, said floor comprising a honeycomb composite and a floor finishing material, said floor finishing material fixed to a top of said honeycomb composite.

13. The method of claim **12** wherein said fixing a floor to said frame comprises fixing a floor comprising polypropylene honeycomb to said frame.

14. The method of claim **13** wherein said fixing a floor comprising polypropylene honeycomb to said frame comprises fixing a floor comprising polypropylene honeycomb with a height of about 0.5 to 1.5 inches to said frame.

15. The method of claim **13** wherein said fixing a floor to said frame comprises fixing a floor comprising polypropylene honeycomb and tile to said frame.

16. The method of claim **15** further comprising fixing said tile to said polypropylene honeycomb with an adhesive.

17. The method of claim **16** further comprising exposing said tile, said polypropylene honeycomb, and said adhesive to ultraviolet light.

18. The method of claim **12** further comprising pre-forming at least one of said studs with at least one hole for making a connection to another stud or fixture or for forming a pathway for a plumbing or electrical line.

19. The method of claim **12** wherein said assembling said frame comprises pre-engineering at least one wall assembly and wherein fixing said floor to said frame comprises fixing said wall assembly to said floor with an adhesive or fastener.

20. The method of claim **19**, wherein said pre-engineering said at least one wall assembly comprises cutting a wall panel of said wall assembly with a computer-controlled cutter.

21. The method of claim **12** further comprising forming in said floor at least one cutout for plumbing, said at least one cutout selected from the group consisting of a cutout for plumbing line connected to toilet, a cutout for plumbing line connected to a vanity, and a cutout for a plumbing line connected to a shower.

22. The method of claim **12** further comprising fixing at least one roller mechanism and mechanical lift to said prefabricated bathroom assembly in order to facilitate transportation to and final placement of said prefabricated bathroom assembly at said construction site.

23. The method of claim **12** further comprising designing said bathroom assembly through the use of Computer Aided Design ("CAD") technology.

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