A fabricated low density concrete foundation/wall panel is provided with a plurality of insulation panels and reinforcing ribs to improve strength and reduce the density of the wall panel. The wall panels are easily placed and interconnected together to quickly provide a foundation adapted to support the main walls of a home, for example. The fabricated wall panels in one embodiment generally includes an inner wall sheathing that is interconnected to the load-supporting segments of the wall panel during fabrication.
METHOD AND APPARATUS FOR FABRICATING A LOW DENSITY WALL PANEL WITH INTERIOR SURFACE FINISHED

[0001] This application claims the benefit of U.S. Provisional Patent Application Ser. Nos. 60/697,169 and 60/744,736, filed Jul. 6, 2005 and Apr. 12, 2006, respectively, which are incorporated by reference in their entirety herein. This application is also related to pending U.S. patent application Ser. No. 11/096,705, which is a continuation-in-part of pending U.S. patent application Ser. No. 10/772,148, filed Feb. 3, 2004, which is a continuation-in-part of pending U.S. patent application Ser. No. 10/423,286, filed Apr. 24, 2003, which is a continuation-in-part of U.S. patent application Ser. No. 10/150,465, now U.S. Pat. No. 6,729,090, filed May 17, 2002, which is a continuation-in-part of U.S. patent application Ser. No. 10/093,292, now U.S. Pat. No. 6,701,683, filed Mar. 6, 2002, each of the pending applications or issued patents being incorporated by reference in their entirety herein.

FIELD OF THE INVENTION

[0002] The present invention relates to building components, and more specifically low density concrete wall panels that are manufactured in a controlled environment and can be selectively interconnected on-site to fabricate modular buildings.

BACKGROUND OF THE INVENTION

[0003] Due to the high cost of traditional concrete components and the expensive transportation and labor costs associated therewith, there is a significant need in the construction industry to provide lightweight, precast, composite building panels that have superior strength and insulative properties. Previous attempts to provide these types of building panels have failed due to the expensive transportation costs and less than ideal insulative and thermal conductivity properties associated with prefabricated concrete wire-reinforced products. Further, due to the brittle nature of concrete, many of the previously used building panels are prone to cracks and other damage during transportation.

[0004] The relatively large weight per square foot of building panels of the prior art has resulted in high expenses arising not only from the amount of materials needed for fabrication, but also the cost of transporting and erecting the modules. Module weight also places effective limits on the height of structures, such as stacked modules e.g., due to load limitations of the building foundations, footings and/or lowermost modules. Furthermore, there is substantial fabrication labor expense that can arise from design, material, and labor costs associated with providing and placing reinforcement materials. Accordingly, it would be useful to provide a wall panel system for modular construction that is relatively light, can be readily stacked to increased heights and, preferably, inexpensive to design, manufacture, transport and erect.

[0005] In many situations panels or modules are situated in locations where it is desirable to have openings therethrough to accommodate doorways, windows, cables, pipes and the like. In some previous approaches, panels were required to be specially designed and cast so as to include any necessary openings, requiring careful planning and design, thus increasing costs due to the special, non-standard configuration of such panels. In other approaches, panels were cast without such openings and the openings were formed after casting, e.g. by sawing or similar procedures. Such post-casting procedures such as cutting, particularly through the thick and/or steel-reinforced panels as described above, is a relatively labor-intensive and expensive process. In many processes for creating openings, there is a relatively high potential for cracking or splitting of the panel or module. Accordingly, it would be useful to provide panels and modules wherein openings such as doors and windows may be integrated in desired locations with a reduced potential for cracking or splitting.

[0006] One other problem associated with metallic wire or bar materials used in conjunction with concrete is the varying rates of expansion and contraction. Thus, with extreme heating and cooling the embedded metallic materials tend to separate from the concrete, thus creating cracks which may lead to exposure to moisture and the eventual degradation of both the concrete and wire reinforcement due to corrosion.

[0007] One example of a composite building panel that attempts to resolve the aforementioned problems inherent in modular panel construction of the prior art is described in U.S. Pat. No. 6,202,375 to Kleinschmidt (the ’375 patent), which is incorporated by reference in its entirety herein. In this invention, a building system is provided that utilizes an insulative core with an interior and exterior sheet of concrete and which is held together with a metallic wire mesh positioned on both sides of an insulative core. The wire mesh is embedded in concrete, and held together by a plurality of metallic wires extending through the insulative core at a right angle to the longitudinal plane of the insulative core and concrete panels. Although providing an advantage over homogeneous concrete panels, the composite panel disclosed in the ’375 patent does not provide the necessary strength and stiffness properties required during transportation and in high wind environments. Further, the metallic wire mesh materials are susceptible to corrosion when exposed to water during fabrication, and have poor insulative qualities due to the high heat transfer properties of metallic wire. Thus, the panels disclosed in the ’375 patent may be more susceptible to failure when exposed to stresses during transportation, assembly or subsequent use.

[0008] In addition, attempts have been made to employ improved building materials that incorporate carbon fiber. For example, in U.S. Pat. No. 6,230,465 to Messenger, et al., which is incorporated herein in its entirety by reference, discloses concrete with a carbon fiber and steel reinforced precast frame. Unfortunately, the insulative properties of this invention are relatively poor due to the physical nature of the concrete and steel. Further, the excessive weight of the panels and inherent problems associated with transportation, stacking, etc. are present. Previously known prefabricated building panels have also not been found to have sufficient tensile and compressive strength when utilizing only concrete insulative foam materials or wire mesh. Thus, there is a significant need for a lightweight concrete building panel that has increased tensile and compressive strength, and which utilizes one or more commonly known building materials to achieve this purpose.

[0009] Furthermore, there is a need for a precast concrete foundation wall system that can be directly positioned on a
prepared soil gravel or sand surface and interconnected to one or more foundation walls. After interconnection, a concrete floor can be poured which is operatively interconnected to the foundation walls and provides additional support.

Accordingly, there is a significant need in the construction and building industry to provide composite building panel walls and foundation walls that may be used in modular construction that are lightweight, that provide superior strength and that have high insulating values. Further, a method of making these types of building panels is needed that is inexpensive, utilizes commonly known manufacturing equipment, and which can be used to mass produce building panels for use in the modular construction of warehouses, low cost permanent housing, hotels, and other buildings. Finally there is a significant need for a precast foundation wall system that can be positioned on a prepared soil or gravel surface and operably interconnected to a poured concrete floor without utilizing onsite forms or other expensive building techniques.

SUMMARY OF THE INVENTION

It is one aspect of the present invention to provide a composite wall panel that has superior strength, high insulating properties, is lightweight for transportation and stacking purposes and is cost effective to manufacture. As used herein the term foundation wall panel, wall panel, foundation/wall panel all refer to a manufactured, low density wall comprised at least partially of concrete and which can be utilized as a foundation wall or any other wall in a commercial or residential structure. Thus, in one embodiment of the present invention, a substantially planar insulating core with interior and exterior surfaces is positioned between concrete panels that are reinforced with carbon fiber grids positioned substantially adjacent to the insulating core. In a preferred embodiment of the present invention, the interior layer of concrete is comprised of a low-density concrete. Furthermore, as used herein, insulating core may comprise any type of material that is thermally efficient and has a low heat transfer coefficient. These materials may include, but are not limited to, Styrofoam®-type materials such as expanded polystyrenes, extruded polystyrenes, extruded polypropylene, polycarbonate, combinations thereof and other materials, including wood materials, rubbers, and other materials well known in the construction industry.

It is a further aspect of the present invention to provide a lightweight, composite concrete wall panel that is adapted to be selectively interconnected to a structural steel frame. Thus, in one embodiment of the present invention attachment hardware is selectively positioned within the wall panel during fabrication that is used to quickly and efficiently interconnect the panel to a structural frame.

It is another aspect of the present invention to provide a low density concrete wall panel that has sufficient compressive strength to allow a second building panel to be stacked in a vertical relationship, on which can support a vertical load in the form of a floor truss or other structural member. Alternately, it is another related aspect of the present invention to provide a composite lightweight wall panel that can be utilized in a corner adjacent to a second wall panel, or aligned horizontally with a plurality of wall panels in a side by side relationship.

It is still yet another aspect of the present invention to provide a composite wall panel that can be easily modified to accept any number of interior textures, surfaces or cladding materials for use in a plurality of applications. Thus, the present invention is capable of being finished with a stucco, siding, brick, drywall other type of interior or exterior surface.

It is yet another aspect of the present invention to provide a composite modular wall panel that can be used to quickly and efficiently construct modular buildings and temporary shelters and is designed to be completely functional with regard to electrical wiring and other utilities such as telephone lines, etc. Thus, the present invention in one embodiment includes at least one utility line which is positioned at least partially within the composite wall panel and which accepts substantially any type of utility line which may be required in residential or commercial construction, and which can be quickly interconnected to exterior service lines. This utility line may be oriented in one or more directions and is generally positioned near the interior surface of the foundation wall panel.

It is yet another aspect of the present invention to provide a novel configuration of the insulating core that assures a preferred spacing between the insulative core and the reinforcing ribs. More specifically, the spacing is designed to provide a gap between the insulative core panels to assure that concrete carbon fiber sturrrups and/or metallic reinforcing bars are properly positioned between the insulative core panels. This improved and consistent spacing enhances the strength and durability of the panel.

It is still yet another aspect of the present invention to provide an insulated concrete wall panel that is comprised of an exterior face wall with a plurality of reinforcing ribs emanating therefrom. The space between the ribs receives foam insulation, thereby increasing the insulating properties of the wall panel and reducing the overall density of the wall panel. The exterior face in one embodiment of the invention is additionally strengthened with at least one carbon fiber grid that generally extends horizontally therethrough. During fabrication, the carbon fiber band is preferably tensioned about 500-3000 lbs, so that once released the carbon fiber band will retract somewhat, thus placing the hardening concrete in a compressed state. The wall panel may also include a footer positioned adjacent to a top edge and a bearing pad positioned at a bottom edge. The footer provides a location for the placement of main building walls and the bearing pad is designed to increase the footprint of the wall panel on a soil or pea stone, and which subsequently becomes operably interconnected to the concrete floor surface.

It is still yet another aspect of the present invention to provide an insulative panel that is quickly manufactured and durable. More specifically, one embodiment of the present invention is manufactured in an exterior face up configuration. As used herein, “face up” configuration refers to the exterior surface of the foundation wall panel being in an uppermost portion of the casting form during fabrication. This configuration allows for the efficient placement of the insulative foam panels, reinforcing strands and carbon fiber grid material. Alternatively, a panel of Dens-Armor, traditional gypsum, drywall, or other building material may be placed in the fixture initially and the remaining members of
the wall placed thereon to yield a wall panel with a completed interior wall. Since the wall panel is substantially comprised of a concrete base material, the finished product is fire resistant, substantially maintenance free, mold resistant, insect proof, wind resistant and projectile resistant. To increase the fire and smoke resistance of the panel, a fire and smoke resistant surface may be affixed to the insulative foam. In addition, the use of insulation in-between the ribs provides a foundation wall panel that is insulated, in one embodiment having an R factor of about 20 or more. Further, with proper treatment of the concrete, the foundation wall panel is substantially water resistant.

[0019] Thus, in one embodiment of the present invention, a low density concrete wall panel is provided, comprising:

[0020] a concrete exterior face wall extending between said first end and said second end;

[0021] a plurality of foam panels positioned adjacent to said concrete exterior face wall, said plurality of foam panels operably spaced to define a reinforcing rib between each of said foam panels which is filled with concrete;

[0022] at least one reinforcing rod positioned within each of said reinforcing ribs; and

[0023] an interior sheathing material interconnected to said plurality of foam panels on a side opposite said exterior face wall.

[0024] Alternatively, it is another aspect of the present invention to provide a method of manufacturing a low density, concrete building wall wherein the interior face material is poured during the manufacturing process. More specifically, rather than interconnecting one or more foam panels to an interior face material such as Dens-Armor or drywall sheets, the gypsum or other interior face material may first be poured within the casting form, and preferably on a plastic sheathing material. Once the gypsum or other material has been poured, the foam panels can be positioned on top of the interior face material, and the concrete subsequently poured within the channels and around the perimeter edges of the building panel as previously described. That is another aspect of the present invention to provide a method of manufacturing a low density concrete foundation/wall panel, comprising:

[0025] a) providing a casting form having a first end, a second end, and lateral edges extending therebetween;

[0026] b) positioning a flexible plastic material within the confines of the form;

[0027] c) interconnecting at least one foam core panel to an interior face building material;

[0028] d) positioning the at least one foam core panel and said interior face building material within said form on said flexible plastic material, wherein a channel is formed between two of said foam core panels;

[0029] e) positioning at least one reinforcing bar in said channel;

[0030] f) providing a layer of concrete within said channels and on an upper surface of said at least one foam core panel;

[0031] g) curing said concrete; and

[0032] h) removing said lightweight, concrete building panel from said form.

[0033] The Summary of the Invention is neither intended nor should it be construed as being representative of the full extent and scope of the present invention. The present invention is set forth in various levels of detail in the Summary of the Invention as well as in the attached drawings and the Detailed Description of the Invention and no limitation as to the scope of the present invention is intended by either the inclusion or non-inclusion of elements, components, etc. in this Summary of the Invention. Additional aspects of the present invention will become more readily apparent from the Detail Description, particularly when taken together with the drawings.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0034] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and together with the general description of the invention given above and the detailed description of the drawings given below, serve to explain the principles of these inventions.

[0035] FIG. 1 is a top perspective view of a structure employing wall panels of one embodiment of the present invention, wherein an inner wall is removed for clarity;

[0036] FIG. 2 is a partial top perspective view of a structure employing wall panels of one embodiment of the present invention;

[0037] FIG. 3 are top sectional views of a wall panel and portions thereof;

[0038] FIG. 4 is a front elevation view of a wall panel of one embodiment of the present invention;

[0039] FIG. 5 is a top plan view of the wall panel shown in FIG. 4;

[0040] FIG. 6 is a right cross sectional view of the wall panel of one embodiment of the present invention;

[0041] FIG. 7 is a perspective view of a wall panel assembly emphasizing the wall/floor interface;

[0042] FIG. 8 is a top plan view of the wall panel of one embodiment of the present invention showing lifting hardware;

[0043] FIG. 9 is a perspective view of a fixture for making one embodiment of the present invention;

[0044] FIG. 10 is a cross-sectional view of the wall panels of the present invention shown employed in a structure;

[0045] FIG. 11 is a perspective view of the prior art method of constructing a foundation/wall panel of one embodiment of the present invention;

[0046] FIG. 12 is a perspective view of a novel method of constructing a foundation/wall panel; and

[0047] FIG. 13 is a perspective view depicting foam panels and the interior surface material being positioned within a casting form.

[0048] It should be understood that the drawings are not necessarily to scale. In certain instances, details that are not necessarily for an understanding of the invention or that
render other details difficult to perceive may have been omitted. It should be understood, of course, that the invention is not necessarily limited to the particular embodiments illustrated herein.

**DETAILED DESCRIPTION**

[0049] Referring now to FIGS. 1-13, various embodiments of the present apparatus and method for making the same is provided herein. More specifically, FIG. 1 depicts a construction installation sight identifying an excavation and a foundation wall positioned in place for the placement of a structure such as a single family home. As shown in the photograph, the foundation walls have been installed and secured together similar to a poured foundation, the novelty being that all of the foundation walls have been precast in a manufacturing facility, delivered on location and erected with a crane or other similar means. Furthermore, the foundation and/or wall panels of the present invention utilize a low density foam material positioned between a plurality of ribs made out of concrete, and which may additionally include steel reinforcing bars for structural support. As further shown in these foundation walls, windows or other openings may be provided as necessary. Furthermore, and not shown in this particular drawing, a method for manufacturing a foundation or wall panel is provided, wherein an interior wall surface of sheet rock or gypsum board, siding, or other building materials may be provided during the manufacturing process, thus eliminating the additional time and expense of installing drywall or other materials after the walls are erected. In one embodiment, a material known as Dens-Armor® is utilized, which is coated glass backed gypsum panel manufactured by Georgia Pacific Corporation of Atlanta, Ga.

[0050] Referring now to FIG. 2, a cut-away sectional view of a plurality of assembled foundation walls of the present invention are provided herein. More specifically, the foundation wall is shown leveled and positioned on a minimum six inch thick base of one-half inch pea stone or other similar base material which is compacted and level after excavation at the building site. Drainage is provided by a perforated PVC pipe or other means well known in the art and is positioned within the pea gravel. Further, a polyethylene film may be provided under the basement floor slab to create a substantially impermeable barrier between the concrete and pea gravel. Once the site is properly leveled, the plurality of foundation wall panels may be positioned on the pea gravel for proper interconnection.

[0051] As shown in the drawing, in one embodiment a recessed joint fastener which utilizes a bolt or other attachment hardware is utilized to properly interconnect the joints. Furthermore, a gasket or other sealing means may be positioned within the joint to provide a waterproof seal between the two wall panels at the juncture of the joints and, to assure there is no penetration from exterior moisture. In one embodiment, the gasket may be a bentonite material, a polyethylene material, rubber, caulk and compound or other sealing materials well known in the art. As additionally shown in FIG. 2, external “cornels” may be manufactured within the wall panel to provide a support for brick materials as necessary depending on the exterior finish of the building. Furthermore, windows, bulk heads, doors and other features can be provided to provide access from the basement or other location. Furthermore, and as shown in the drawing, the wall panels may be installed on location with the use of recessed erection lift lugs. Furthermore, threaded inserts for the attachment of the sill on the top of the foundation wall panel may be provided during manufacturing to allow for further erection of the building. Additionally, recessed vertical utility voids may be provided within the foam panels during the manufacturer of the low density foundation/wall panel to provide access points for utilities such as electrical wiring, water, hot water heating, etc.

[0052] Referring now to FIGS. 3A and 3B, a cross-sectional view of one foundation/wall panel of the present invention is provided herein. More specifically, a 45° corner is provided on a wall panel for use generally in a corner location. As depicted the wall panel further includes foam panels with a three inch spacing therebetween which is filled during the manufacturing process with concrete and rebar or other reinforcing materials. The exterior wall outer surface may additionally include rebar, carbon fiber, or other materials for strengthening and structural integrity. Furthermore, as shown in FIGS. 3A and 3B, the interior wall surface is manufactured with the use of Dens-Armor, drywall, or other interior construction materials which are generally interconnected to the foam panels during the manufacturing of the wall panel, and prior to the concrete being poured.

[0053] Referring now to FIG. 3C-3J, a variety of cross-sectional elevation and plan views are provided herein and which provide additional detail to various embodiments of the present invention. For example, FIG. 3C shows an upper portion of a wall panel, which further includes ½ inch diameter plastic inserts placed at 24 inch centers which are utilized for attaching the sill plate on top of the wall panel. Furthermore, the positioning of the foam panels, the plywood material, and/or the Dens-Armor material is shown positioned on the interior surface of the panel. As further depicted in FIG. 3C-3G, reference is made to a ¼” plywood material used in combination with a Dens-Armor sheathing material. As referenced herein, the ¼”×48”×6” plywood material is utilized either along a lower portion of the wall panel or an upper portion of the wall panel, and is generally used as a fastener friendly strip for interconnecting interior trim materials such as baseboard.

[0054] Referring now to FIG. 3E, the positioning of the EPS foam panels with respect to the Dens-Armor sheathing materials is provided herein, and with regard to the concrete which is positioned between the EPS foam panels during manufacturing to provide a structural rib. More specifically, in one embodiment of the present invention the foam panels are first glued or otherwise attached to the interior face sheathing material, which is positioned into the bottom portion of a cast form. Prior to positioning the foam panels and interior face sheathing materials in the form, it is preferable to utilize a plastic or other flexible material to position on the steel forms to prevent rust or other discoloration from showing on the exterior surface of the interior sheathing material. The sheathing panels are then butted next to each other, at which time in a preferable embodiment a 2 inch by ½ inch EPS foam strip or other material is positioned over the joint to assure that concrete when poured does not permeate between the seam of the sheathing material during manufacturing. Referring now to FIG. 3F-3G, additional details are provided of the connection inserts which are shown placed in the gypsum wall sheath-
ing near the bottom of the panel, and also with respect to the lower portion of the wall panel.

[0055] Referring now to FIG. 3H, detail is provided wherein a floor joist is shown positioned on top of a foundation wall panel, which is bolted to a sill on the upper portion of the foundation/wall panel for interconnection purposes. As additionally shown in FIG. 3H, 1.5 inch straps may be used for interconnection purposes of the floor joists, and positioned at 32 inch centers. FIG. 3I depicts lifters in the upper portion of the foundation and/or wall panel which are used for transporting and lifting the wall panels, while the positioning of rebar or other structural materials are shown in FIG. 3I in a drawing depicting the lower portion of the wall panel.

[0056] Referring now to FIGS. 4-5, additional detailed drawings are shown of a typical foundation/wall panel. As shown in this drawing, the positioning of the rebar within the channels between the low density foam materials is shown herein, along with a cut-out wherein a window may be provided during the forming process. In one embodiment of the present invention, it is anticipated that the window frame can actually be positioned within a cut-out in the sheathing material during the formation of the foundation wall, and during which time the window is positioned while the concrete is poured in place. Alternatively, a void or cut-out can be formed and positioned in place of the window, the concrete poured, and the window inserted after the installation of the building panel. As shown in FIG. 5, greater detail is provided with regard to the positioning of the rebar, the foam panels, and the plastic inserts and lifters used for interconnecting the sill, and the bolt anchors respectively.

[0057] Referring now to FIG. 6, a side elevation photograph of one wall/foundation panel of the present invention is provided herein and which depicts additional detail. More specifically, the exterior concrete wall portion is shown, which is immediately positioned adjacent to the EPS foam material, which in turn is interconnected to the Dens-Armor or other sheathing material.

[0058] Referring now to FIG. 7, additional details are provided showing a typical joint between the interior sheathing material. More specifically, after construction of the wall panel, the joint between the Dens-Armor, sheet rock, or other material has a slight seam which is easily taped and finished once the foundation/wall panels are erected and positioned in place. Furthermore, a concrete basement floor or other material can be poured after the erection of the walls. Additionally, a wood strip or other similar material can be utilized at the lower or uppermost portion of the Dens-Armor or other interior wall surface, and which is utilized for interconnecting interior trim to the foundation/wall panel.

[0059] Referring now to FIG. 8, a photograph is provided showing additional detail of the foundation/wall panel of the present invention. More specifically, the Dens-Armor, drywall or other interior sheathing material is shown positioned against the upper portion of the foundation wall, and which includes a utility access for positioning utility wires, piping, or other utility access. Furthermore, a lift lug is shown which is used for transporting and erecting the foundation/wall panel, as well as a sill insert which is used for interconnecting the sill plate on top of the foundation wall.

[0060] Referring now to FIG. 9, a front perspective view of a corner portion of a casting form used for manufacturing a wall panel is provided herein. More specifically, a 45° mitered corner is utilized for creating a 90° corner between two wall panels. As appreciated by one skilled in the art, this angle can be modified depending on the geometry of the building site. Furthermore, the plastic sill insert is shown which will be embedded within the concrete and allows for the interconnection of the sill, while a lift lug is shown positioned for allowing for the transportation, erection and positioning of the foundation wall at the building site. As provided herein, steel or other metal materials are generally utilized for the forms and other molds during the manufacturing of the wall panels, although other materials known in the art could also be used.

[0061] Referring now to FIG. 10, a cross sectional front elevation view of one embodiment of the present invention is provided herein. More specifically, a foundation wall panel is shown on a lower portion of the drawing, which is interconnected by the use of a threaded rod through a sleeve to a stem deck floor or other flooring material. Furthermore, a manufactured wall panel is shown operably interconnected to an upper portion of the stem deck floor, and wherein a portion of the threaded rod extends from the foundation wall panel through the stem deck floor, and through a lower portion of the wall panel for interconnection purposes. As further shown in FIG. 10, the wall panel includes a wall board finish made out of Dens-Armor, drywall, or other building materials and which is interconnected to the foundation wall panel during manufacturing. Furthermore, the same interior wall board finish may be utilized on the foundation wall as well. As additionally shown in FIG. 10, a brick shelf or corbel may be manufactured integral to the foundation wall, and which provides a ledge or other support mechanism for supporting bricks, or other veneered materials.

[0062] Referring now to FIGS. 11-12, photographs depicting the manufacturing of a foundation panel of the present invention is provided herein. More specifically, FIG. 11 depicts the prior art method of manufacturing the building panel, while FIGS. 12 and 13 depict a new method of manufacturing. With respect to FIG. 11, the foam panels were previously required to be held down within the bottom portion of the casting form, with a plurality of wood or metallic hold downs. Not utilizing the hold downs allows the foam panels to float once the concrete is poured, thus creating inconsistencies within the wall panel and a potential loss of structural integrity. Furthermore, in the prior art method shown in FIG. 11, no interior sheathing or other surface was provided below the panels, and an interior drywall or other material would be installed after the wall panel was erected.

[0063] Referring now to FIG. 12, and depicting a novel method of manufacturing, the foam panels in one embodiment are first glued or otherwise interconnected to an interior face sheathing material such as Dens-Armor. Preferably, two of the foam panels are glued to the sheathing material, and including a three inch void between the foam panels for the positioning of one or more pieces of reinforcing material for structural support and to provide a channel to create a reinforcing rib which is filled with concrete. Once the foam panels and interconnected interior sheathing materials are placed adjacent one another, a three inch foam strip or other material may be positioned on top of the seam created between the sheets of interior sheathing materials,
thus preventing the concrete from leaking between the seams. Once the rebar and other structural support materials have been placed within the structural ribs, the concrete is poured on top of the foam panels and within the structural ribs. The excess concrete on the exterior wall portion of the reinforced wall is skimmed off, and corbels or other distinct exterior shapes can be created within the form as necessary.

[0064] Referring now to FIG. 13, a photograph is provided showing the installation of the foam panels within the casting form. More specifically, two foam panels are shown glued to an exterior face material such as Dens-Armor or drywall. The plurality of foam panels are then laid on a plastic liner or other materials to prevent rust or other contamination from contacting the interior face material or sheathing. As the exterior face sheathing materials are laid side by side, a three inch void is created between each of the foam panels, thus forming the reinforcing ribs. After each of the foam panels and interconnected interior face materials are positioned within the casting form, rebar or other reinforcing materials are positioned within the reinforcing channels, and preferably along the perimeter edges of the low density concrete wall panels. Once the reinforcing materials are positioned within the channels and around the perimeter edges, concrete is poured within the reinforcing ribs and along the perimeter edges and on top of the foam panels to create the exterior face of the low density concrete building panel.

[0065] In an alternative embodiment of the present invention, it is anticipated that gypsum, drywall materials or other building materials could actually be poured into the casting form as opposed to interconnecting the exterior sheathing materials to the foam panels. Once the interior sheathing material is poured into the casting form, the foam panels can be positioned on top of the interior sheathing material, the rebar positioned within the channels created by the foam panels, and the concrete subsequently created between each of the foam panels to rigidify the interior face material would be eliminated.

[0066] In another aspect of the invention not identified in FIG. 13, once the foam panels and interconnected internal sheathing materials are laid down within the casting form, a 3 inch foam material or tape can be positioned on top of the seams created between the interior face sheathing materials. By positioning the foam or tape on top of the seams, concrete is substantially prevented from permeating through the seams and disfiguring the interior face of the wall panel. After the wall panel is erected on the building site, the seams created between each of the Dens-Armor or other interior face material can be subsequently taped and textured to create a smooth finish similar to traditional drywall or gypsum board.

[0067] As generally provided in the drawings and photographs, foundation/wall panels are shown in a variety of embodiments. More specifically, foundation wall panels may be formed in a variety of shapes and sizes depending on the application and design criteria. In addition, the foundation wall panels may be arranged such that they are interconnected, or have a bend integrated therein, such that a plurality of angled walls are provided by one panel. Further, it should be understood by one skilled in the art that a plurality of apertures 46 may be integrated into the wall panel(s) 2 so that conduits for electrical lines, sewage lines and/or water lines may be accommodated.

[0068] In addition, reinforcing bars preferably span substantially the entire height of the foundation wall panel 2. More specifically, one embodiment of the present invention includes reinforcing bars that are integrated into the reinforcing ribs of the panel from the plate to the shoe, i.e. lateral edge to lateral edge, providing additional strength and rigidity.

[0069] Other embodiments of the present invention include reinforcing bars integrated horizontally between a first and second end of the wall panel. One skilled in the art will appreciate that the horizontal reinforcing bars and the longitudinal reinforcing bars may be interconnected to increase strength and rigidity. In addition, carbon fiber may be added to the ribs, the shoe, and/or the plate, in conjunction with steel reinforcing bars or alone, to increase the wall panel strength. Further, foundation wall panels may be provided by the present invention may also include lifters and inserts that receive a lifting device to facilitate transportation and erection of the foundation wall panels 2.

[0070] Furthermore, an interconnection scheme employed in certain embodiments of the present invention is shown. More specifically, one embodiment of the foundation wall panels may be interconnected via a bolt or other attachment hardware. Preferably, the foundation wall panels include an angled outer edge that engages a matching angled edge of an adjacent foundation wall panel. These edges are similar to that of miter joints as known in the art. Bolt pockets may also be provided that are located adjacent to the upper edge and the lower edge of the foundation wall panels for interconnection. The bolt pockets allow for the insertion of a fastener, such as a bolt through coincident apertures on each wall panel. The adjacent foundation wall panels can then be securely interconnected by a nut or other attachment hardware known in the art. Alternatively, welding may be utilized to prevent movement of the two panels. In addition, the floor plates may be included, affixed to either an inner corner or an outer corner of the finished interconnected joint, to add increased strength thereto. These plates are interconnected to the foundation wall panels via fasteners, such as bolts, or alternatively welded.

[0071] As further provided, one method of constructing the insulative foundation panel is shown and described. Embodiments of the present invention are constructed with the exterior surface “face up”, which is believed novel. Initially, the insulation panels are placed in the casting form, wherein the reinforcing ribs are defined by the spaces between the insulative panels. Reinforcing bars are then positioned within the space for the reinforcing ribs. Concrete is then poured into the space. One skilled in the art will appreciate that additional steps, such as vibration, may be employed to ensure that the consistency of the concrete is per specification, and to improve the density of the concrete. Finally, wood, foam, or metal screw strips may be applied along the edges of the ribs. Although not shown, the insulative foundation panel may include a footer and a bearing pad that is placed when the ribs are formed, and which may be tied into the face wall with reinforcing bar and stirrups as well. The footer may subsequently be covered at least partially with concrete when the concrete floor is poured during installation at the building site, thus providing additional structural support.

[0072] With regard to the concrete utilized in various embodiments of the present application, the face wall and
associated ribs may be comprised of a low density concrete such as Cret-o-Lite™, which is manufactured by Advanced Materials Company of Hamburg, N.Y. This is an air dried cellular concrete that is nailable, drillable, screwable, sawable and very fire resistant. In a preferred embodiment, the face wall is comprised of a dense concrete material to resist moisture penetration and in one embodiment is created using VISCO CRETE™ or equal product, which is a chemical that enables the high slump short port life liquefaction of concrete to enable the concrete to be placed in narrow wall cavities with minimum vibration and thus create a high density substantially impermeable concrete layer. VISCO CRETE™ is manufactured by the Sika Corporation, located in Lyndhurst, N.J. The face wall is preferably about 2 inches thick. This concrete layer has a compression strength of approximately 5000 psi after 28 days of curing.

[0073] Positioned within the ribs is one or more reinforcing bars “rebar”, which are generally manufactured from carbon steel or other similar metallic materials. Preferably, the reinforcing bar has a diameter of at least about 0.25 inches, and more preferably about 0.75-1.50 inches. As appreciated by one skilled in the art, the reinforcing bars may be any variety of dimensions or lengths depending on the length and width of the wall panel, and the strength requirements necessary for any given project.

[0074] The foregoing description of the present invention has been presented for purposes of illustration and description. Furthermore, the description is not intended to limit the invention to the form disclosed herein. Consequently, variations and modifications commenced here with the above teachings and the skill or knowledge of the relevant art are within the scope in the present invention. The embodiments described herein above are further extended to explain best modes known for practicing the invention and to enable others skilled in the art to utilize the invention in such, or other, embodiments or various modifications required by the particular applications or uses of present invention. It is intended that the dependent claims be construed to include all possible embodiments to the extent permitted by the prior art.

1. A low density, concrete wall panel having a first end, a second end and lateral edges extending therebetween, comprising:
   a concrete exterior face wall extending between said first end and said second end;
   a plurality of foam panels positioned adjacent to said concrete exterior face wall, said plurality of foam panels operably spaced to define a reinforcing rib between each of said foam panels which is filled with concrete;
   at least one reinforcing rod positioned within each of said reinforcing ribs; and
   an interior sheathing material interconnected to said plurality of foam panels on a side opposite said exterior face wall.

2. The low density wall panel of claim 1, further comprising a reinforcing rib extending around a perimeter edge of said wall panel, said reinforcing rib comprised of concrete and a metal reinforcement material.

3. The low density wall panel of claim 1, further comprising a plurality of utility channels extending at least partially between said first end and said second end which are adapted to receive electrical wiring, piping or other utilities.

4. The low density wall panel of claim 1, further comprising a lifting lug interconnected to at least one of said first end and said second end.

5. The low density wall panel of claim 1, wherein said perimeter edges are comprised of concrete extending from said exterior face wall to said interior face wall.

6. A method for fabricating a low density concrete building panel, comprising the steps of:
   a) providing a casting form having a first end, a second end, and lateral edges extending therebetween;
   b) positioning a flexible plastic material within the confines of the form;
   c) interconnecting at least one foam core panel to an interior face building material;
   d) positioning the at least one foam core panel and said interior face building material within said form on said flexible plastic material, wherein a channel is formed between two of said foam core panels;
   e) positioning at least one reinforcing bar in said channel;
   f) providing a layer of concrete within said chapels and on an upper surface of said at least one foam core panel;
   g) curing said concrete; and
   h) removing said lightweight, concrete building panel from said form.

7. The method of claim 6, further comprising the step of positioning an interior frame within said casting form prior to said providing a layer of concrete wherein an opening for a window or a door is provided.

8. The method of claim 6, further comprising the step of positioning at least one lift anchor within said concrete building panel to facilitate the removal of said lightweight building panel from said casting form.

9. The method of claim 6, wherein said foam core is comprised of at least one of an expanded polystyrene material, an extruded polypropylene and a polysioxyanurate material.

10. The method of claim 6, further comprising the step of reinforcing at least one of a plurality of perimeter edges of said concrete building panel with at least one of a metallic reinforcing bar and a carbon fiber material.

11. The method of claim 6, further comprising the step of vibrating said first concrete material, wherein a density of said first concrete material is increased.

12. The method of claim 6, wherein interconnection of said at least one foam core panel and said interior face building material is accomplished within the casting form.

13. The method of claim 12, where said interior face building material is poured within said casting form during fabrication of the low density building panel.

14. A low density fabricated concrete wall panel, comprising an upper end, a lower end and lateral edges extending between, comprising:
an interior sheathing material positioned substantially between said upper end, said lower end and said lateral edges;

a plurality of foam panels positioned adjacent to said interior sheathing material and oriented to define a space between said at least two of said plurality of foam panels between said upper end and said lower end;

a cavity extending within at least one of said plurality of foam panels between said upper end and said lower end, said cavity adapted to receive a utility;

a concrete material positioned on an exterior surface of said plurality of foam panels to define an exterior face and within said space between said at least two of said plurality of foam panels to define a reinforcing rib.

15. The low density wall panel of claim 14, wherein said sheathing material is comprised at least partially of a gypsum material.

16. The low density wall panel of claim 14, wherein said plurality of foam panels are comprised of at least one of an expanded polystyrene material, an extruded polypropylene and a polyisocyanurate material.

17. The low density wall panel of claim 14, further comprising a metallic rod positioned within said space and formed between said at least two of said plurality of foam panels.

18. The low density wall panel of claim 14, further comprising a lift anchor positioned along a perimeter edge to facilitate lifting the low density wall panel.