

PREFABRICATED WALL PANEL AND ASSEMBLY

BACKGROUND

Technical Field

5 Embodiments of the invention relate to prefabricated wall panels and particularly to wall panels which comprise engineered cementitious composite (ECC) and autoclaved aerated concrete (AAC) materials to provide lightweight structural components with advantageous properties including but not limited to fire resistance, flexural strength and compressive strength.

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Description of Related Art

Traditional construction techniques rely on the field assembly of discrete elements by individual trades that may not share a common purpose. Traditional practices often result in a complex on-site management task,
15 ample opportunities for failure, less than optimal performance of the overall system, and long construction process.

In view of the above and other problems, improved construction techniques are highly desired.

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Summary

According to one embodiment of the invention, a prefabricated wall panel comprises: a first layer which includes an engineered cementitious
25 composite; a second layer which includes an autoclaved aerated concrete, the second layer being fixedly attached to the first layer; and at least one rib which traverses the second layer and is bonded to the first layer, wherein the at least one rib includes the engineered cementitious composite.

30 The wall panel may further comprise a third layer which includes the engineered cementitious composite, wherein the third layer and the first layer are arranged to fixedly interpose the second layer therebetween, and wherein the at least one rib is bonded to the third layer and the first layer.

According to one embodiment of the invention, an assembly comprises: at least two adjoining prefabricated wall panels according to any embodiments of the invention; and a formwork arranged in combination with at least the first layer of each of the wall panels to provide a cavity for fabricating a column
5 therein.

According to one embodiment of the invention, a prefabricated modular unit comprises: a plurality of wall panels and corner wall panels, both according to any embodiments of the invention, wherein the plurality of wall
10 panels and corner wall panels are fixedly connected to one another to provide at least one box-like enclosure, wherein at least one of the plurality of wall panels is provided with at least one opening for access; and a beam secured to the plurality of wall panels and corner wall panels.

According to one embodiment of the invention, a prefabricated modular unit comprises: a frame; and a plurality of wall panels according to any embodiments of the invention, wherein the plurality of wall panels are
15 fixedly connected to the frame to provide at least one box-like enclosure, wherein at least one of the plurality of wall panels is provided with at least one opening for access.
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According to one embodiment of the invention, a method of fabricating a wall panel, comprises: casting a first layer on a mold, the first layer including an engineered cementitious composite; overlaying a second layer on the first
25 layer, the second layer includes an autoclaved aerated concrete and is arranged to provide at least one cavity; and dispensing a material into the at least one cavity to form a rib which traverses the second layer and is bonded to the first layer, wherein the material includes the engineered cementitious composite.

30 The method may further comprise dispensing the material onto the second layer to form a third layer overlaying the second layer, wherein the at least one rib is bonded to the first layer and the third layer.

The method may further comprise: arranging a rigid member at an end of the wall panel; and dispensing the material onto the second layer to form a third layer overlaying the second layer, wherein the at least one rib is bonded to the first layer and the third layer, and interposed therebetween.

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According to one embodiment of the invention, a method for fabricating an assembly of adjoining wall panels according to any embodiments of the invention, the method comprises: arranging a plurality of wall panels juxtaposed to each other; arranging a formwork in combination
10 with at least the first layer of each of the juxtaposed wall panels to provide a cavity; fabricating a column in the cavity; and removing the formwork.

According to one embodiment of the invention, a method for fabricating a modular unit, comprises: providing a frame; providing a
15 plurality of wall panels according to any embodiments of the invention; and fixedly connecting the wall panels to the frame to provide a box-like enclosure wherein at least one of the wall panels is provided with at least one opening for access.

20 **Brief Description of the Drawings**

Embodiments of the invention are disclosed hereinafter with reference to the drawings, in which:

FIG. 1A is a front view of a prefabricated wall panel according to one
25 embodiment of the invention;

FIG. 1B is a cross-sectional view of the prefabricated wall panel taken along line A-A of FIG. 1A;

FIG. 1C is a side view of the prefabricated wall panel of FIG. 1A;

FIG. 2A is a front view an assembly of prefabricated wall panels
30 according to one embodiment of the invention;

FIG. 2B is a cross-sectional view of the assembly taken along line B-B of FIG. 2A;

FIG. 2C is a side view of the assembly of FIG. 2A;

FIGs. 3A to 3F illustrate an example sequence of assembling a module enclosure using prefabricated wall panels and corner panels;

FIG. 4A is a top cross-sectional view of an enclosure module assembled from wall and corner panels according to one embodiment of the invention;

FIG. 4B is a perspective view of the corner panel of FIG. 4A;

FIG. 4C is a side view of the corner panel of FIG. 4B;

FIG. 4D is a top view of the corner panel of FIG. 4B;

FIG. 4E illustrates a floor panel being connected to the corner panel of FIG. 4A;

FIG. 5A illustrates a formwork according to one embodiment of the invention;

FIG. 5B is a side view of FIG. 5A;

FIG. 5C is a sectional view taken along line A-A of FIG. 5A;

FIG. 5D is a perspective view of FIG. 5A;

FIG. 5E is a partial close-up view of FIG. 5C;

FIG. 5F is a partial close-up view of FIG. 5C;

FIG. 5G is a partial close-up view of FIG. 5D;

FIG. 6A illustrates a formwork according to one embodiment of the invention;

FIG. 6B is a side view of FIG. 6A;

FIG. 6C is a sectional view taken along line A-A of FIG. 6A;

FIG. 6D is a partial close-up view of FIG. 6B;

FIG. 6E is a partial close-up view of FIG. 6B;

FIG. 7A is a front view of a wall panel or formwork which is provided with suitable lifting means;

FIG. 7B is a side view of FIG. 7A;

FIG. 7C is a perspective view of FIG. 7A;

FIG. 8A illustrates two wall panel permanent forms which are employed in combination with an aluminum formwork for casting an in-situ column;

FIG. 8B is a partial close-up view of FIG. 8A;

FIG. 8C is a partial close-up view of FIG. 8A;

FIG. 9A illustrates two wall panel permanent form which are employed in combination with an aluminum formwork for casting an in-situ beam;

FIG. 9B is a partial close-up view of FIG. 9A;

FIG. 10A illustrates a frame;

FIG. 10B illustrates the frame of FIG. 10 being connected with wall panels;

5 FIG. 10C illustrates an assembly of room modules;

FIG. 11A illustrates a room module that may be prefabricated from the frame of FIG. 10A;

FIG. 11B is a partial close-up view of FIG. 11A;

FIG. 11C is a partial close-up view of FIG. 11A;

10 FIG. 11 D illustrates the assembled steel framework of the room module of FIG. 11A and with the wall panels omitted for illustrative clarity;

FIG. 12A illustrates modular units of different dimensions being stacked together horizontally and vertically during building assembly;

15 FIG. 12 B illustrates an assembled form of the modular units of FIG. 12A;

FIG. 13A illustrates a compressive strength performance of a wall panel according to one embodiment of the invention;

FIG. 13B illustrates a flexural strength performance of a wall panel according to one embodiment of the invention.

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Detailed Description

In the following description, numerous specific details are set forth in order to provide a thorough understanding of various illustrative embodiments of the invention. It will be understood, however, to one skilled in the art, that
25 embodiments of the invention may be practiced without some or all of these specific details. In other instances, well known process operations have not been described in detail in order not to unnecessarily obscure pertinent aspects of embodiments being described. In the drawings, like reference
30 numerals refer to same or similar functionalities or features throughout the several views.

Embodiments of the invention relate to multi-functional prefabricated or precast wall panels (MPP), particularly to precast concrete sandwich panels.

The prefabricated wall panels are embedded with insulation and energy systems, interior and exterior finishes in a single prefabricated wall panel. The invention offers improvements in several of the target areas including, but not limited to, disaster resistance and safety, durability, energy efficiency and environmental impact, and life cycle affordability of buildings.

With the invention, buildings can be constructed using offsite manufactured technologies in which structures, finishes, insulation, and energy systems are integrated into the prefabricated wall panels which may be used as load-bearing wall, curtain wall, corner wall panel, floor, ceiling panel and roof panel. These prefabricated wall panels are designed to facilitate quick assembly at the construction site, thus reducing construction time and labor costs. Particularly, the prefabricated wall panels may be employed in combination with steel frames, columns and/or beams in constructing an enclosure or building.

PROPERTIES

The prefabricated wall panels of the invention together with the inherent properties of concrete yield a building system with an extremely long life that is resistant to natural disasters, virtually maintenance-free, extremely comfortable, highly energy efficient, and that has an initial cost that is comparable to conventional homes.

Particularly, the prefabricated wall panels include an engineered cementitious composite (ECC). The pre-blend ECC mix may include, but not limited to, cement, sand, fly ash, admixtures and reinforcing fibers which provide the ECC with high flexural strength. The high flexural strength allows the masonry to be reinforced into a prefabricated wall system. ECC is regarded as highly versatile construction materials possessing unique properties of strength and serviceability. Its advantageous properties include strength, toughness, water-tightness, lightness, durability, fire resistance and environmental stability. FIGs. 13A and 13B illustrate, respectively, the

compressive strength performance and flexural strength performance of a prefabricated wall panel according to one embodiment of the invention.

One of the remarkable properties of the prefabricated wall panels of the invention is its fire resistance capability i.e. voiding differential rate of expansion, cracking and disintegration. It also neither spalls due to fire and nor requires the plastering to achieve good fire resistance. The good fire resisting property of aerated concrete is due to its closed pore structure, as heat transfer through radiation is an inverse function of the number of air-solid interfaces traversed. A fire resistance test conducted on a specimen wall panel measuring 3000 mm (height) x 3000 mm (width) x 105 mm (thickness) yielded the following results. There was no loss of integrity throughout the heating period of 260 minutes. At 260 minutes of test, the maximum mean temperature rise and maximum temperature rise above initial temperature on the unexposed face of specimen were 70.1 °C and 110.2 °C respectively. Therefore, the insulation of the 105 mm thick wall panel meets British Standard (BS) 476: Part 22 1987 of 260 minutes.

FEATURES

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FIG. 1A is a front view of a prefabricated wall panel 10 according to one embodiment of the invention; FIG. 1B is a cross-sectional view of the prefabricated wall panel 10 taken along line A-A of FIG. 1A; FIG. 1C is a side view of the prefabricated wall panel of FIG. 1A. The prefabricated wall panel 10 of FIGs. 1A and 1C comprises two spaced-apart layers 11, 13 (hereinafter "a first layer 11" and "a third layer 13"), a centre or second layer 12 which is fixedly interposed between the spaced-apart layers 11, 13, and at least one rib 14 which traverses the second layer 12 and is bonded to the third layer 13 and the first layer 11.

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The first layer 11 and the third layer 13 include an engineered cementitious composite (ECC) which includes but is not limited to a product marketed under the trademark "ecc crete". The ECC is a highly ductile

cementitious material which may be made by mixing a pre-blend mix of cement-based composite material with superplasticiser or water

5 The second layer 12 includes an autoclaved aerated concrete (AAC) which may be made from an aerated mix of cement, flyash, aluminum powder, admixtures. The use of ECC and AAC in wall panels according to the invention provides a structurally efficient combination for lightweight structural components. In particular, the prefabricated walls comprising of AAC and ECC composites have great excellent absorbing capabilities under impact
10 force. The potential advantages of panelized construction using AAC core as building material include lightweight, energy efficient, easy to use, fire resistant, environmentally friendly, weather resistant, pest resistant, durable, and acoustically efficient.

15 The rib(s) 14 traverse the second layer 12 and are fixedly connected between the first layer 11 and the third layer 13. The rib(s) 14 are to transmit forces between the first 11 and the third layer 13. In FIGs. 1A to 1C, the rib(s) 14 are integrally formed with the first layer 11 and the third layer 13 such that the rib(s) 14, the first and the third layers 11, 13 which are all formed of ECC
20 fully encase the second layer 12. It is to be appreciated that other variations and configurations of the rib(s) may be possible. For example, the rib(s), the first layer and the third layer may partially enclose the second layer such that the unenclosed parts of the second layer may be visible.

25 In certain embodiments of the invention, the first layer 11 and the third layer 13 are thinner relative to the second layer 12 and the rib(s) 14. The thinner first 11 and third layer 13 may be readily penetrated with drills and/or saws to facilitate plumbing, mechanical and electrical works. The first layer 11 and the third layer 13 may also contain a denser and higher strength material
30 relative to the second layer 12.

In certain embodiments, the wall panel includes the first layer, the second layer and at least one rib which traverses the second layer and is bonded to the first layer.

FIG. 2A illustrates an assembly 20 of prefabricated wall panels 10 of FIG. 1A. The wall panels 10 may be assembled by applying suitable grouting to bond the side ribs of the wall panels 10 and/or providing bolts through adjacent side ribs to secure the wall panels 10 together, or other suitable means. FIG. 2B is a cross-sectional view of the assembly taken along line B-B of FIG. 2A; FIG. 2C is a side view of the assembly of FIG. 2A.

WET CASTING FOR PRODUCTION OF PREFABRICATED OR ECC-CRETE WALL

A method of fabricating a wall panel (e.g. FIG. 1A) is described as follows. A first layer which comprises an ECC is casted on a flat mold. A second layer which comprises an AAC overlays the first layer. The second layer may be provided as a plurality of AAC panels such that cavities are provided between adjacent AAC panels. The ECC material is then dispensed into the cavities to form the rib(s). For certain embodiments where a third layer is required, the ECC material is further dispensed onto the second layer to form the third layer. If required, a steel mesh may be laid upon the second layer before forming the ribs and third layer.

Thereafter, the fabricated wall panel may be provided with bores or openings for various bolt connections and other purposes. Interior and/or exterior finishes including imprint may be incorporated during the above-described fabrication process. The variety of finishes that homeowners have come to expect may be provided through careful control of mixture composition and curing and through the use of rubber molds, dyes, and additives.

In certain embodiments, prior to forming the third layer, a rigid member, e.g. steel hollow section, is arranged at an end of the wall panel. An ECC material is then dispensed onto the second layer to form a third layer overlaying the second layer, wherein the at least one rib is bonded to the third layer and the first layer, and wherein the first layer and the third layer interpose the rigid member therebetween.

CORNER PANELS AND POD CONSTRUCTION

Prefabricated corner panels (e.g. L-shaped panels) which provide a similar two-layer or three-layer arrangement as described above may also be provided to connect wall panels for modular construction of an enclosure, pod or room. The corner panel may include bolt holes at peripheral or side ribs for facilitating the corner panel to be secured to an adjacent wall panel. Providing corner panels addresses a problem of overlapping adjacent walls due to incompatibility in dimensions of wall panels with on-site conditions. FIGs. 3A to 3F illustrate an example sequence of assembling a module enclosure using prefabricated wall panels and corner panels. Particularly, FIG. 3A illustrates an assembly of two wall panels and a corner panel; FIG. 3B illustrates another wall panel secured to the assembly of FIG. 3A; FIG. 3C illustrates other wall panels secured to the assembly of FIG. 3B along both sides of the corner panel; FIG. 3D illustrates yet other wall and corner panels secured to the assembly of FIG. 3C to complete the enclosure module; FIG. 3E illustrates inbuilt or insitu column 35 or beam 36 or structural frame secured to the enclosure of FIG. 3D; FIG. 3F illustrates a slab 37 with structural topping or a roof truss with roofing secured to the enclosure module of FIG. 3E. The various wall panels and corner panels may be secured to adjacent panels by bolting through the side ribs or other suitable means.

FIG. 4A is a top cross-sectional view of an enclosure assembled from wall and corner panels according to one embodiment of the invention. The prefabricated wall panel 40 in FIG. 4A comprises a first layer 41 which includes an ECC and a second layer 42 which includes an AAC which is fixedly attached to the first layer 41, and at least one rib 44 which traverses the second layer 42 and is bonded to the first layer 41. A corner panel 46 (see FIGs. 4B to 4D) has a similar two-layer arrangement as described in the present paragraph. Particularly, corner panel 46 has a first layer 41 which includes an ECC and a second layer 42 which includes an AAC which is fixedly attached to the first layer 41, and an area 45 where the first layer 41 and rib 44 is integrated. The corner panel 46 may include a steel rod 47 traversing the panel height and configured to be received into a floor panel 48

to secure both panels together (see FIG. 4E). This embodiment may be useful in applications, e.g. pods, where tile works (not shown) may be installed in the interior of the assembled enclosure module.

5 **PREFABRICATED WALL PANELS WITH ECC SKIN/LAYER AS PERMANENT FORMWORK**

The prefabricated wall panels of the invention may provide a modular system of permanent forms for construction of columns and beams,
10 construction of reinforced concrete and steel reinforced concrete, or encasement of steel reinforced concrete. Employing the prefabricated wall panels for as permanent forms are particularly advantages as the relative thinness of the ECC material coupled with its strength allows for the formation of a very strong and lightweight precast permanent forms. Due to the high
15 density of ECC material, permanent forms made with the typical thickness are impervious.

FIGs. 5A to 5G illustrate a wall panel 50 which comprises a first layer 51 and a third layer 53, both of which include an ECC, and a second layer 52
20 which is fixedly interposed between the first and the third layer 51, 53, and at least one rib 54 which traverses the second layer 52 and is bonded to the third layer 53 and the first layer 51. FIG. 5B is a side view of FIG. 5A, which illustrates the arrangement and extended dimensions of the first layer 51 relative to the third layer 53. FIG. 5C is a sectional view taken along line A-A
25 of FIG. 5A which illustrates the extended dimensions of the first layer 51 relative to the third layer 53 to provide for recessed areas (see FIGs. 5C to 5G) at the horizontal and vertical ends of the wall panel 50 for receiving steel hollow sections 57 therein to form a plurality of columns. These columns or rigid member(s) may be interposed between, and also fixedly connected to,
30 the first layer 51 and the third layer 53 during fabrication of the wall panel 50.

PRE-FABRICATED WALL PANELS WITH PERMANENT FORMS FOR INSITU BEAMS AND COLUMNS

FIG. 9A illustrates two wall panels 80 (for example, but not limited to
5 the wall panels 50 illustrated in FIGs. 5A to 5G, or wall panels 60 illustrated in
FIGs. 6A to 6E) which are employed in combination with an aluminum
formwork 95 for casting an in-situ beam. Particularly, the wall panels 80 may
be juxtaposed along their sides; the aluminum formwork 95 may be arranged
with the ECC layer 81 of the adjoining wall panels 80 to provide a formwork
10 for the in-situ beam. Concrete may then be dispensed into the aluminum
formwork 95. After the concrete is suitably cured, the aluminum formwork 95
may be removed to expose the concrete beam 98 which is now bonded with
the wall panels 80. FIG. 9B is a partial close-up view of FIG. 9A and
illustrates a recessed area provided by the aluminum formwork 95 and the
15 wall panels 80 and a vertical steel hollow section 92. This method of providing
formwork for casting in-situ beam eliminates the need for erecting
conventional scaffolding for outside formwork.

PREFABRICATED WALL PANELS INTERFACING WITH 20 STRUCTURAL STEEL

FIG. 6A illustrates a wall panel 60 which comprises a first layer 61
and a third layer 63, both of which include an ECC, and a second layer 62
which is fixedly interposed between the first and the third layer 61, 63, and at
25 least one rib 64 which traverses the second layer 62 and is bonded to the third
layer 63 and the first layer 61. FIG. 6B is a sectional view taken along line A-
A of FIG. 6A and FIG. 6C is a sectional view taken along line B-B of FIG. 6A.
FIG. 6D is a partial close-up view of FIG. 6B and illustrates interlocking drip
joints between a steel hollow section 67 disposed at one end of the wall panel
30 60 and a structure beam 68, which provides for water-tight connection. FIG.
6E is a partial close-up view of FIG. 6B and illustrates interlocking drip joints
65 which provide for water-tight connection between the wall panel 60 and a
slab 69.

FIG. 8A illustrates two wall panels 80 (for example, but not limited to the wall panel illustrated in FIGs. 5A to 5G, or wall panel 60 illustrated in FIGs. 6A to 6E) which are employed in combination with an aluminum formwork 85 for casting an in-situ column. Particularly, the wall panels 80 may be juxtaposed along their sides; the aluminum formwork 85 may be arranged with the ECC layer 81 of the adjoining wall panels 80 to provide a formwork for the in-situ column. An I-beam (not shown) may be disposed within the aluminum formwork, and concrete may then be dispensed into the aluminum formwork 85. After the concrete is suitably cured, the aluminum formwork 85 may be removed to expose the concrete column which is now bonded with the wall panels 80. FIG. 8B is a partial close-up view of FIG. 8A, which illustrates a recessed area provided by the aluminum formwork 85 and the wall panels 80. This method of providing formwork for casting in-situ column eliminates the need for erecting conventional scaffolding for outside formwork.

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FIG. 8C is a partial close-up view of FIG. 8A and illustrates a side steel hollow section 87 of the wall panel 80 which is connected, by welding, to a steel I-beam of a reinforced concrete column.

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LIFTING OF PRE-FABRICATED WALL PANEL

FIGs. 7A to 7C illustrates a wall panel e.g. as illustrated in FIGs. 6A and 7A which is provided with suitable means, e.g. removable eyebolts 75, such that cables 76 or ropes can attach the removable eyebolts to a lifting jig 77 which in turn is lifted by hoisting systems or cranes for transferring the panel.

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MODULAR UNIT

The prefabricated wall panels of the invention may be integrated into a prefabricated modular unit or pre-engineered volumetric unit. The modular unit may employ steel as structural materials, e.g. open framed steel modules that are substantially designed or customized to specific requirements. The modular units may be prefabricated in the factory in a variety of lengths or

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dimensions such that the modular units may be assembled into different configurations on site. Such modular units may be provided with internal fixtures and fittings as required. The modular units may be transported to a building site and assembled into a building. This method of assembling modular units at a building site is particularly advantageous in reducing construction time and yet providing desirable compressive and flexural strength due to the use of wall panels in accordance with the invention.

FIG. 10A illustrates a prefabricated structural steel frame which is connected with wall panels of the invention (see FIG. 10B) in a configuration as desired. The wall panels casted with embedded steel hollow sections are fixedly connected or welded to the frame which may be made of steel. The embedded top hollow sections of the different wall panels may be spliced together to form the top frame of the modular unit thereby closing up the module into a box-like enclosure. The box shape is designed to withstand the locally high force that exists at lifting positions; these top adjacent members and their connection may be strengthened to resist these forces. Diagonal braces may also be embedded into the wall panels. FIG. 10C illustrates an assembly of room modules.

FIG. 11A illustrates a room module that may be prefabricated from the frame of FIG. 10A. Various wall panels with opening(s) for access, e.g. inbuilt doors and windows, are connected to the frame of FIG. 10A by suitable means, e.g. welding, bolt connections. FIG. 11B is a partial close-up view of FIG. 11A and illustrates wall panels being connected to an I-beam of the frame by welding the steel hollow sections thereto. FIG. 11C is a partial close-up view of FIG. 11A and illustrates steel hollow sections of adjacent wall panels being connected by welding. The adjacent wall panels may be further provided with bolt or screw connections. FIG. 11 D illustrates the assembled steel framework of the room module of FIG. 11A and with the wall panels omitted for illustrative clarity.

FIG. 12A illustrates modular units of different dimensions being stacked together horizontally and vertically during building assembly. Each modular

unit is provided with side wall panels, and concrete slab floor. In certain modular units, depending on the dimensions, the concrete slab floor may be provided with embedded steel beams. FIG. 12B illustrates an assembled form of the modular units of FIG. 12A.

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In certain embodiments, the modular unit has a top or side portion which is uncovered.

ADVANTAGES

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In view of the above, it will be appreciated that the following advantages will be achieved:

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1. Development and evaluation of structural connections that can be assembled rapidly and inexpensively in the field; that are robust and readily verifiable; that can withstand seismic loads; and that minimize the effects of thermal bridging.

2. Development of inexpensive, durable surface treatments that are impermeable to water without the need for additional materials.

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3. Development of industrialization concepts for the precast industry that facilitate the translation of traditional masonry into precast assembly details – these concepts must address information management, process planning, and manufacturing processes.

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4. Development of wall system details that provide high effective R-values (after accounting for bridging); minimize infiltration; and maximize the amount of thermal mass located inside the building envelope.

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5. Development of sufficient cost data and estimating models so that residential precast projects can be reliably estimated and builder financial risk reduced.

6. Development and dissemination of economic models for the cost of ownership that reflect not only first cost but also energy, maintenance, and insurance costs for MPP construction relative to conventional construction.

7. Development of techniques for accurately assessing the environmental life cycle cost of MPP construction and identification of approaches for minimizing the environmental impact.
8. Development of construction standards, codes, and field inspection protocols for precast projects that may lack the level of engineering supervision common to larger commercial projects.

Other embodiments will be apparent to those skilled in the art from consideration of the specification and practice of the invention. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to limit the disclosed embodiments of the invention. The embodiments and features described above should be considered exemplary, with the invention being defined by the appended claims.

What is claimed is:

1. A method of fabricating a wall panel, the method comprising:
casting a first layer on a mold, the first layer including an engineered cementitious composite;
overlaying a second layer on the first layer, the second layer includes an autoclaved aerated concrete and is arranged to provide at least one cavity; and
dispensing a material into the at least one cavity to form a rib which traverses the second layer and is bonded to the first layer, wherein the material includes the engineered cementitious composite.
2. The method of claim 1, further comprising dispensing the material onto the second layer to form a third layer overlaying the second layer, wherein the at least one rib is bonded to the first layer and the third layer.
3. The method of claim 1, further comprising:
arranging a rigid member at an end of the wall panel; and
dispensing the material onto the second layer to form a third layer overlaying the second layer, wherein the at least one rib is bonded to the first layer and the third layer, and interposed therebetween.