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Stronger wall system

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ABSTRACT

A new prefabricated wall panel is the basic unit of a new, more efficient and stronger wall system. The wall panel is manufactured from a plurality of foam sections sized to leave vertical and horizontal voids into which concrete is later poured, each foam section having an inner and outer surface and two sides; and a plurality of fastening strips. The fastening strips are longitudinal metal strips being situated between the sides of two foam sections. Each fastening strip has two longitudinal fastening strips projecting perpendicularly to the longitudinal fastening strip and the fastening strips being adjacent to the outer surface of the two foam sections. The fastening strip also has a plurality of clearance holes in the longitudinal fastening strip, a plurality of embed tabs projecting from the edge opposite the fastening strips, each embed tab having at least one hole, and between each pair of embed tabs, a foam tab to hold the two inner sides of the foam sections in place and partially separate the foam sections from the concrete to be poured into a form.

Fig. 4

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Fig. 4

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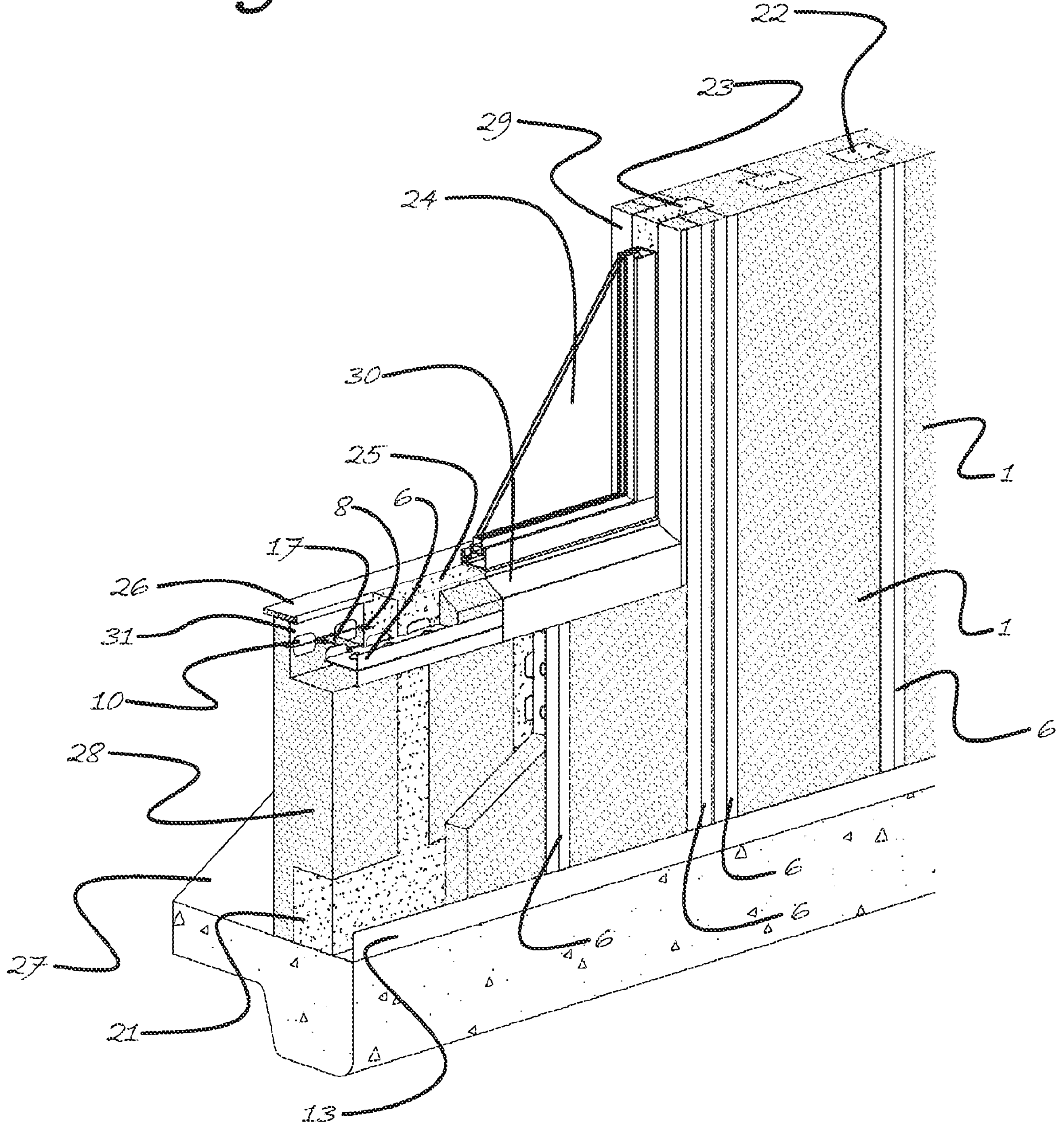

STRONGER WALL SYSTEM

TECHNICAL FIELD

[0001] The present invention relates to insulated wall systems and more particularly to a wall system that includes foam wall panels connected by fastening strips that are embedded in concrete studs and beams formed in situ within the wall panels.

BACKGROUND

[0002] Single and multifamily residential and light commercial building construction, especially in North America, has been constructed predominately with wood frame or concrete block techniques. Both of these methods have provided safe, secure, economical and code compliant structures for most of the twentieth century. However, the growing populations, pressure on the world's wood and energy resources, and ever increasing land resources utilized for landfill due to relatively short life cycles of conventional structures have caused society in general and the building construction industry to rethink new construction recyclability, and durability or a much extended life cycle all at a cost that is affordable on both a first cost and cost of occupancy basis. In addition, new construction technologies must be scaleable. Many new methods have been developed to address one or more of these critical issues but few if any address all of them. Most come at a cost premium or are impractical for implementation in mass volumes.

[0003] An efficient building envelope has been proven to be the most cost effective method of maximizing the overall efficiency of a building structure and continues to keep energy costs low over the lifetime of the structure. The building envelope provides the barrier between the interior conditioned space and the outdoor environment. The energy efficiency of a building envelope is measured in two ways: the efficiency of the insulation and minimizing air infiltration and air leakage through the building envelope. The exterior walls of a structure are a key component and a significant contributor to the overall energy efficiency of the building envelope.

[0004] Concrete wall and floor construction has been a long time standard construction material in most of the world for all types of structures. Over the past 25 years, insulated concrete forms (ICF) systems have gained popularity and widespread acceptance and use, principally in North America. ICF systems provide a method of building pour-on-site concrete

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walls without the use of capital intensive and labor intensive permanent concrete forms, but generally ICF technology does not adequately address the issues of scalability and affordability. In particular, the current ICF systems require trained installers and large amounts of concrete to be poured.

SUMMARY OF THE INVENTION

[0005] In one aspect, the present invention provides an external tension reinforcement device for concrete, the device comprising

a) a fastening strip comprising a longitudinal T formed from a perpendicular junction of an external flange and a connecting flange;

b) a set of internal flanges connected to the connecting flange on a side opposite the connection with the external flange; and

c) a set of embed tabs that extend from the connecting flange beyond the internal flanges, the embed tabs extending horizontally only part way into a channel into which concrete is to be poured;

whereby only the embed tabs are connected to the concrete and the rest of the fastening strip forms a support external to the concrete.

[0006] In one aspect, the present invention provides a pair of external tension reinforcement devices for concrete comprising, the devices each comprising

a) each device comprising
   i. a vertical fastening strip comprising a longitudinal T formed from a perpendicular junction of an external flange and a connecting flange;
   ii. a set of internal flanges connected to the connecting flange on a side opposite the connection with the external flange; and
   iii. a set of embed tabs that extend from the connecting flange beyond the internal flanges, the embed tabs extend horizontally only part way into a channel into which concrete is to be poured; and
b) each device being arranged in parallel on an opposite face of a poured concrete floor or wall.

[0007] A prefabricated wall panel has a. a plurality of foam sections sized to leave voids into which concrete is later poured, each foam section having an inner and outer surface and two

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sides; and b. a plurality of metal strips, the metal strips composed of a i. a longitudinal metal strip being situated between the sides of two foam sections, ii. two longitudinal fastening strips attached perpendicularly to a longitudinal metal strip, the fastening strips being adjacent to the outer surface of the two foam sections; ii. a plurality of clearance holes in the longitudinal metal strip; iii. a plurality of embed tabs projecting from the edge opposite the fastening strips; iv. each embed tab having at least one hole; v. between each pair of embed tabs, a foam tab to hold the two inner foam sections in place and partially separate the foam from the concrete to be poured into a form.

[0008] A partially prefabricated wall system is made from a plurality of wall panels, each panel is manufactured from i. a plurality of foam sections sized to leave voids into which concrete is later poured, each foam section having an inner and outer surface and two sides; ii. a plurality of metal strips, the metal strips are fabricated with a) a longitudinal metal strip being situated between the sides of two foam sections, b) two longitudinal fastening strips attached perpendicularly to a longitudinal metal strip, the fastening strips being adjacent to the outer surface of the two foam sections; c) a plurality of clearance holes in the longitudinal metal strip; d) a plurality of embed tabs projecting from the edge opposite the fastening strips; e) each embed tab having at least one hole; f) between each pair of embed tabs, a foam tab to hold the two inner foam section in place and partially separate the foam from the concrete to be poured into a form. The system also has a track into which one end of the wall panels is placed; a cap which fits over the upper ends of a plurality wall panels; and concrete poured into the top of the panels to fill the voids in the panels.

[0009] Unless the context clearly requires otherwise, throughout the description and the claims, the words “comprise”, “comprising”, and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of “including, but not limited to”.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] For a further understanding of the objects and advantages of the present invention, reference should be had to the following detailed description, taken in conjunction with the accompanying drawing, in which like parts are given like reference numbers and wherein:

[0011] Figs. 1a, 1b and 1c show the finished appearance of a wall built with the inventive system, from the top (Fig. 1a), from the outside or inside (Fig. 1b) and from a side view (Fig. 1c);

[0012] Figs. 2a and 2b are various views of the inventive fastening strip that is the core of the inventive wall. Fig. 2a is a side perspective view of the strip, showing the pre- manufactured hooks and tabs that embed in the concrete to replace rebar; Fig. 2b is a top view.

[0013] Fig. 3 is a perspective, cutaway view of a section of the wall after the panels are set up and the concrete studs and beams in place;

[0014] Fig. 4 is a cutaway, perspective view of the window section of a wall after the panels are set up, the concrete studs and beams are formed and a window installed; and

[0015] Figs. 5a and 5b are front and side views respectively of the window in place in the constructed wall.

DETAILED DESCRIPTION

[0016] My system provides an efficient method of reinforcing pour-in-place concrete walls, concrete tilt-up walls, reinforced concrete floors systems, and reinforced concrete flat or slanted roof systems. Common to each of these applications is the use of rigid foam materials (typically expanded polystyrene or EPS) that serve as the material for the poured concrete forms in lieu of temporary site constructed plywood based formwork or removable metal forms. These EPS forms remain in place after the concrete has been placed and cured, providing highly efficient rigid foam insulation to the structure. Other examples of foam suitable include, but are not limited to, extruded polystyrene (XPS), polyurethanes, polyisocyanurates, polystyrenes and combinations thereof.

[0017] My new system also saves significant amounts of labor because I have designed the wall panels to incorporate two poured horizontal concrete beams. This not only saves on rebar purchase, but on the labor required to place the rebar. These two horizontal concrete beams increase the strength of the walls to the extent that walls built with my new system withstand

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severe weather. With these innovations, a safe, quiet, long-lasting concrete house (or other building) can be built for less money and in less time.

[0018] The basic system is shown in Figs. 1-3. In Fig. 1a is a view from the top of a partially constructed panel 50, showing the rigid foam material 1 which makes up much of the panel, except for the longitudinal channels 2, into which concrete is poured onsite to form concrete studs 22, an upper concrete beam 20 and a lower concrete beam 21 . Either side of the panel 50 includes notches 14 for pressing adjacent panels together for a tight fit. Connecting the rigid foam material 1 are the fastener strips 3. As can be seen in Fig. 1b (a front view of a wall panel 50), the rigid foam material 1 and the fastener strips 3 extend the height of the panel. Additional internal foam inserts 28 are placed between the two foam panels 1 used to form a wall panel 50 to create the longitudinal channels 2. The internal foam inserts 28 are generally shorter than the height of the foam panels 1, thereby creating an upper channel 5 and a lower channel 6. Fig. 1c is a side view of a panel 50 showing foam material 1 and the upper channel 4 which is later filled with concrete to create a continuous upper beam 20 at the top of the length of the wall. Likewise, the lower channel 5 at the bottom of the panel 50 is filled with concrete to form lower beam 22 that runs the length of the wall.

[0019] Unique to my technology is the use of single-piece, formed-metal fastener strips 3 that are partially connected to and embedded into the concrete. Figs. 2a and 2b show two views of fastener strips 3. The fastening strips 3 include a first, external flange 6, and second internal flange 10 and a third connecting flange 19. External flange 6 and internal flange 10 are generally parallel to each other with the connecting flange 19 being positioned generally perpendicular to the external 6 flange and internal flange 10. The fastening strips 3 are generally configured as an assembly of back-to-back “C” shaped channels into which the foam panels 1 are placed. The external flange 6 can serve as a as a fastening surface 6a for drywall, siding, stucco, brick or stone as well as connecting points for wall-hung cabinets, and ledger boards. The external flange 6 is positioned to be flush or nearly flush to the exterior surfaces of the foam material 1. The fastening surface 6a can be covered with water- resistant or water-proof tape to finish the wall. At the factory, the fastener strips 3 are inserted into the EPS foam panels 1 and positioned such that the fastener strips 3 run parallel to the vertical axis of the panel 50. The internal flange 10 can be formed as a series of small sections 10a, 10b etc. as shown in Fig. 2a or it could be formed as a single contiguous piece. In the embodiment shown in Figs 2a and 3, a series of

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embed tabs 8 protrude beyond the surface of the internal flange 10 in a generally perpendicular fashion. Once the panel 50 is assembled, the embed tabs 8 protrude into the cavity voids where the concrete is to be poured.

[0020] The embed tabs 8 are optionally equipped with single or preferably double attachment holes 9 to which hooks 11 can be attached by inserting knobs on the hook holder into the attachment holes 9. The hooks 11 are optionally positioned in the factory into concrete voids 4 and 5 (Fig. 1c) for placement of rebar after the panels are stood up in situ. These embedded tabs 8 may be evenly spaced along the vertical axis of the fastening strip 3 and perpendicular to the horizontal axis. The connecting flange 19 may include one or more holes 7 that can be used to run electrical wiring, plumbing or anything else that is suited to be positioned internal to the wall.

[0021] Also unique to my invention is the use of these fastening strips 3 to serve as tension reinforcement for the concrete eliminating the requirement for most of the conventional vertical reinforcing bars (rebars) that concrete wall systems typically require. Tension loads in the concrete studs 22 are transferred to the vertical fastening strips 3 via the embed tabs 8 that are integral to the fastening strips 3. This method of reinforcing concrete allows tension loads to be counteracted outside of the concrete and at a location where a greater mechanical advantage can be attained than with conventional reinforcing bar that is totally embedded within the concrete. Thus, my inventive wall gains increased strength with less concrete. The combination of concrete and the partially embedded fastening strips 3 result in a composite assembly. Because less rebar installation is performed on site, there is less labor, materials and time in building the walls, containing these fastening strips 3.

[0022] Specifically, the fastener strips 3 are an important component to my invention as they serve several purposes within the invention. For example, the fastener strips 3 provide a fastening surface 6a on the outer side of the external flange 6 for materials like drywall and plaster lath on interior and exterior finishes like stucco (with wire lath), siding, brick, and stone veneers. In the case of the inventive pour-in-place concrete walls, the fastening strips 3 run vertically from the bottom of the wall panel to the top of the wall panel form and on both the interior side of the wall and alternatively on the exterior side of the wall.

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[0023] As explained in more detail below, components of my technology, including but not limited to walls and adaptable to floors and ceiling/roofs) all share the use of my inventive integral reinforcing and fastening system (Figs. 1a- 3) that eliminates the requirement for most of the conventional rebar within poured concrete walls and floor systems by transferring tension loads to formed fastening strips 3 that are connected with and partially embedded in the concrete component of the wall system. In addition to providing the tension reinforcement to the concrete, the fastening strips 3 position and hold the foam material/panels 1 in place and act as the connector between the concrete and foam material/panels. These strips also function as a fastening point for interior and exterior veneer surfaces and as mounting points for cabinets, electrical boxes, plumbing and other mechanical items.

[0024] Another important inventive aspect of the invention is a computerized design and manufacturing system and structural analysis system that accurately and efficiently produces a wall building kit composed of a series of interlocking wall panel components manufactured to meet the specific architectural design and engineering parameters of a building envelope. The kits include precut wall height panels for straight and curved wall sections, panels sized to fit around windows and doors and around corners of any angle. The computerized software design system is integrated with a computerized manufacturing system to yield a finished product that is precise, accurate and economical. The building envelope kits are designed for ease of installation by general construction labor with minimal training. No skilled labor is required, as the panel components are manufactured to eliminate on-site modification of the panel system, with only basic tools required.

[0025] The core technology of the invention and common to each of its applications are panels 50 with a series of formed fastening strips 3 that serve multiple purposes. The fastening strips 3 are preferably manufactured from light gauge steel and are generally configured as an assembly of back-to-back “C” shaped channels that have a series of metal embed tabs 8 that protrude from the joint between the two “C” channels on one side of the assembly only. The two-piece assembly is spot welded, riveted together or otherwise permanently attached. An alternative design is the strip assembly manufactured and formed from one piece. The one-piece alternative does not require rivets and the embed tabs 8 are formed out of the same piece of material. The fastening strips can also be manufactured from other types of metal, structural plastics, composites and the like

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[0026] The embed tabs 8 are designed and positioned such that as the concrete is poured into the forms, the tabs 8 are surrounded by concrete and when the concrete cures, a permanent bond is created between the concrete and the tabs, thereby permanently bonding the strip assembly to the concrete. These tabs 8 are designed to allow the concrete to mechanically grab onto and permanently hold the tabs 8 in place. Through the embed tabs 8, the curing concrete forms a mechanical bond with the strips 3. This bond between the concrete and the strips 3 allows tension loads within the concrete to be transferred from the concrete to the strips. Properly engineered, the combination of the concrete studs 22 and beams 20, 21 and the fastening strips 3 creates a composite system with the concrete acting as the compression component of the composite assembly and the fastening strips 3 acting as the tension member of the assembly. The fastening strips 3 act as the vertical reinforcement within a poured concrete wall, eliminating much of the need for conventional steel rebar.

[0027] Our preliminary structural analysis of this composite system shows that a wall can be 40% stronger while using 30% less concrete when compared to a wall built utilizing conventional steel rebar reinforcing. This dramatic improvement results from our optimal placement of the tension member (fastening strip 3) of the composite assembly outside of the concrete where the greatest mechanical advantage is realized.

[0028] In the inventive wall systems, the fastening strips 3 provide a substitute for conventional vertical reinforcing bars within the system, provide a joiner strip and seal to fill vertical grooves in the foam material/panel 1 and provide a fastening surface 6a for interior and exterior veneer surfaces like drywall, siding and others, as well as mounting holes/points 7 for cabinets, electrical boxes, plumbing and other mechanical items. The fastening strips 3 extend from the base of the wall form panel 50 to the top of the wall form panel and are located on the centerline of the individual concrete studs 22 with one strip 3 located per concrete stud 22. The strips 3 are parallel to each other and generally alternate from the interior side of the wall to the exterior side such that the spacing of the strips on each side of the wall system is regularly spaced to facilitate the installation of drywall on interiors and other finishes on the exterior.

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Example 1. Panelized Foam Form for Wall System

[0029] The inventive building system is manufactured of lightweight wall panels 50 (containing voids into which concrete is poured). The preferred weight of a panel 50 of a width of four feet and height of 8 feet is about 60 pounds. This is easily manageable by one or two workers. A two-person team is preferred because the lightweight panel 50 is affected by breezes. Generally, the voids within the individual panels (e.g. the longitudinal channels 2, upper channel 4 and lower channel 5) are designed so that the resulting shape of the concrete after pouring and curing results in a continuous horizontal bond beam at the bottom 21 and the top 20 of the wall with regularly spaced vertical concrete columns/ studs 22 adjoining the lower 21 and upper 20 horizontal beams. The shape of these concrete studs and beams can be square, round or rounded, rectangular, trapezoidal or even polyhedral in shape, or a combination thereof.

[0030] Panelized. The foam forms are manufactured according to the height of the wall specified in the building plans. For example, if the construction plans call out a 9' wall height, then the panel form components will be manufactured 9' tall. Walls taller than one story in height can be constructed by stacking tiers of panels on top of each other. If the wall length is not a multiple of four feet, a narrower panel is provided.

[0031] Customized. Each form panel 50 is custom manufactured and specific to the building plans for a given structure. Each panel 50 is designed to fit within a specific position in the wall or walls being constructed, and each panel or group of panels is designed to form straight wall sections, curved wall sections, corners, window openings and/or door openings in order to precisely match the desired final wall configuration as specified in the construction drawings. In other words, a series of panels 50 are manufactured for each individual installation and as such this series of panels forms a “kit” which is shipped to the jobsite and is set up in sequence to form the desired wall configuration.

[0032] Structure. The configuration of the final concrete structure formed by the panels 50 within the walls is not a solid concrete wall but consists of a concrete base beam or curb 21 at the bottom of the wall, a concrete bond beam 20 at the top of the wall and vertical concrete columns 22 between the curb and the bond beam. The system allows for window and door

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openings to be placed at any point within the system and all window and door openings are surrounded by concrete.

[0033] Fastening Strips. Vertical fastening fastening strips 6 (the “strips”) for attaching finishes to the system are integral to the system. These strips provide a hard fastening point 6a for drywall and cabinets on the interior and stucco, siding, brick and stone veneers on the exterior. These strips are flush or nearly flush with the surface of the forms, and their spacing can be varied to accommodate the maximum allowable spans for drywall and other materials.

[0034] In contrast with wood houses in which extra wood planks are put around the windows and doors, I have designed the fastening strips 3 for paired strip 3 placements around the windows and doors. The paired strips are attached to each other by segments/spacers 17 whose ends have stubs that are inserted into the hook holes 9. All window and door openings are surrounded by metal or plastic fastener strips 3 to facilitate the finishing of these openings.

Example 2. Installation of the Wall System

[0035] Figs. 3- 4 show a cutaway of a wall and can facilitate understanding of the installation. At the bottom is the floor slab 27 on which a metal track 13 sits. Rebar 15 is embedded in the slab 27 and pierces track 13. A metal track 13 or parallel retainer angles are also fastened to a footing, stemwall or floor slab 27. This track 13 defines the position of the wall and receives the bottom end 1a of the lightweight panels. The rebar 15 or similar material affords a means of connection between the wall and the foundation or floor slab. Placement, size and location of these items are pre-determined by structural engineering plans and placed within the concrete prior to or when the foundation and slab are poured.

[0036] The bottom end 1a of the lightweight foam panels 50 are set in place within the metal track 13 on the foundation according to the building plans and the job-site drawings. Panels have been marked so that the installer can identify the panel components and their positioning on the project diagram and relative positioning to other components. The panels 50 are aligned and straightened. The sides of each panel 1 have notches 14 so the panels fit tightly together.

[0037] Metal caps 12 are installed at the top of the wall. These caps 12 are manufactured preferably in 10’ or longer lengths than the combined widths of several panels 50 and serve to

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align multiple panels and insure straighter walls. The caps 12 are lightweight metal “C” channels designed to fit over the top of the foam forms at the top of both the interior and exterior sides of the wall. The caps 12 can be cut to cover shorter walls or to fill in gaps in longer walls. The caps 12 can also be formed from other metals, plastic and composite materials.

[0038] Several sections of wall panels 50 are aligned with the bottom track 13 and together with the top caps 12. The top caps 12 are screwed into place while alternating with the installation of bracing (not shown) which are kickers that typically run from the top of the wall to a ground stake on the exterior of the structure or tied to the slab or foundation on the interior side of the wall. Preferably there is a brace at each corner in both directions and at a maximum of 10’ spacing over the length of any wall section. Bracing or kickers should have an inline turnbuckle for final wall adjustment.

[0039] Each foam form is manufactured with guides for vertical rebar columns or studs (not shown) and hooks 16 for horizontal rebar where required or as specified by the structural engineering plans for a specific project. These guides and hooks 16 help to position where rebar is placed and also serve as a visual cue as to where to place the rebar. The guides and hooks are installed within each form panel 50 component during the manufacturing process according to the structural engineering requirements. Generally, there is one extra fastening strip 3 in each corner and in each concrete stud 22 next to window and door openings. These guides and hooks 16 also make it easy for inspectors to identify any missing rebar in the system prior to pouring concrete as empty hooks and guides are easily identified. Because these hooks 16 and guides are strong enough to hold the position of the rebar against the forces of the concrete pour, no additional wire ties are required, eliminating the labor, materials and costs of tying off the rebar.

[0040] A concrete slurry of predetermined strength and specification is pumped into the wall panels 50 from the top of the walls. A preferred concrete mix has a yield strength of 3,000 PSI at a slump of 4’ to 5’ at the discharge end of the hose. I also recommend the use of a hydraulic group pump with a maximum of a 2” delivery line to facilitate easy and safe handling of the concrete. As the concrete is pumped into the panel forms 50, the concrete is vibrated to minimize any voids or air entrapment within the wall system. The concrete and rebar form the structural component of the wall; and the foam material/panels 1, which initially served as the

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form for the concrete, now stay in place and function as the wall insulation and a mounting surface for interior and exterior finishes.

[0041] After the concrete is adequately cured, any bracing that was installed may be removed and construction may continue.

Example 3. Installing a Window

[0042] Figs. 4 and 5 shows a window 24 in situ in the inventive wall system. The sides of the window opening have been premade for the window, and all that needs to be done is the installation of the window, inside window sill and outside finish sill. At the upper right of the partial window shown in Fig. 4 are two pairs of fastening strips 3 and between them is a double-width concrete stud 23. At the lower edge of the window opening, there are two lateral, facing fastening strips 14 connected by a segment/space 17 and surrounded with foam panels 1 that constitutes the form for the concrete sill 25 under the window. Window and door openings are generally “bucked out” utilizing a temporary plywood or metal buck that is installed at the factory as a part of the manufacturing process. The purpose of the bucking is to provide added strength to the window opening while the concrete is being placed and to determine the final dimensions of the openings. After the concrete is placed and adequately cured, the window and door bucks are removed and returned to the manufacturer for reuse, and the window or door is installed within the opening using a header fastening surface 18 and jamb fastening surface 29. A window sill 26 may be included to complete the window 24 and secured in place using an outer sill fastening surface 30 and inner sill fastening surface 31.

[0043] Although specific embodiments have been illustrated and described herein, those of ordinary skill in the art will appreciate that any arrangement calculated to achieve same purposes can be substituted for the specific embodiments shown. This disclosure is intended to cover any and all adaptations or variations of various embodiments of the invention. It is to be understood that the above description has been made in an illustrative fashion, and not a restrictive one. Combinations of the above embodiments, and other embodiments not specifically described herein will be apparent to those of skill in the art upon reviewing the above description. The scope of various embodiments of the invention includes any other applications in which the above structures and methods are used. Therefore, the scope of various

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embodiments of the invention should be determined with reference to the appended claims, along with the full range of equivalents to which such claims are entitled.

[0044] In the foregoing description, if various features are grouped together in a single embodiment for the purpose of streamlining the disclosure, this method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments of the invention require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus the following claims, and such other claims as may later be added, are hereby incorporated into the description of the embodiments of the invention, with each claim standing on its own as a separate preferred embodiment.

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CLAIMS

1. An external tension reinforcement device for concrete, the device comprising

a) a fastening strip comprising a longitudinal T formed from a perpendicular junction of an external flange and a connecting flange;

b) a set of internal flanges connected to the connecting flange on a side opposite the connection with the external flange; and

c) a set of embed tabs that extend from the connecting flange beyond the internal flanges, the embed tabs extending horizontally only part way into a channel into which concrete is to be poured;

whereby only the embed tabs are connected to the concrete and the rest of the fastening strip forms a support external to the concrete.

2. The external tension reinforcement device for concrete of claim 1, wherein the internal flanges connected to the connecting flange alternate with the embed tabs.

3. The external tension reinforcement device for concrete of claim 1, wherein the external flange comprises a flat surface on a side away from the connecting flange.

4. The external tension reinforcement device for concrete of claim 3, wherein the flat surface of the external flange accepts drywall, siding, stucco, brick and stone.

5. The external tension reinforcement device for concrete of claim 3, wherein the flat surface of the external flange accepts wall-hanging cabinets and ledger boards.

6. The external tension reinforcement device for concrete of claim 1, wherein at least one of the embed tabs has at least one attachment hole.

7. The external tension reinforcement device for concrete of claim 6, wherein at least some of the embed tabs have two attachment holes for accepting knobs from a hook holder that supports a rebar horizontally.

8. A pair of external tension reinforcement devices for concrete comprising, the devices each comprising

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a) each device comprising

i. a vertical fastening strip comprising a longitudinal T formed from a perpendicular junction of an external flange and a connecting flange;

ii. a set of internal flanges connected to the connecting flange on a side opposite the connection with the external flange; and

iii. a set of embed tabs that extend from the connecting flange beyond the internal flanges, the embed tabs extend horizontally only part way into a channel into which concrete is to be poured; and

b) each device being arranged in parallel on an opposite face of a poured concrete floor or wall.

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Fig. 1a

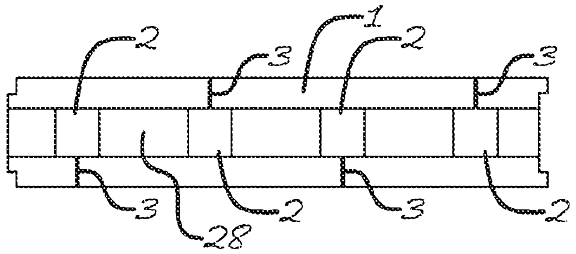

Fig. 1b

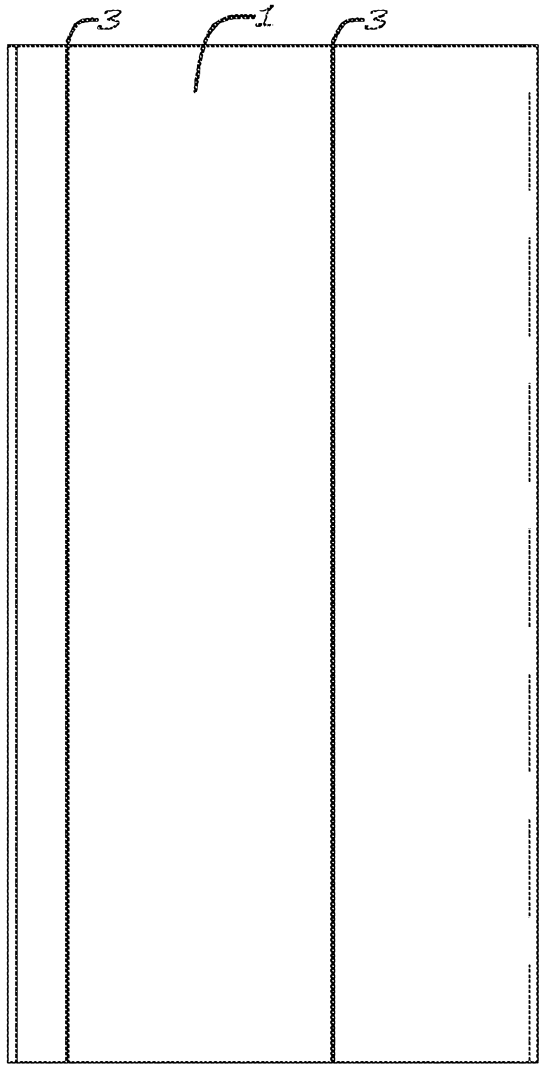

Fig. 1c

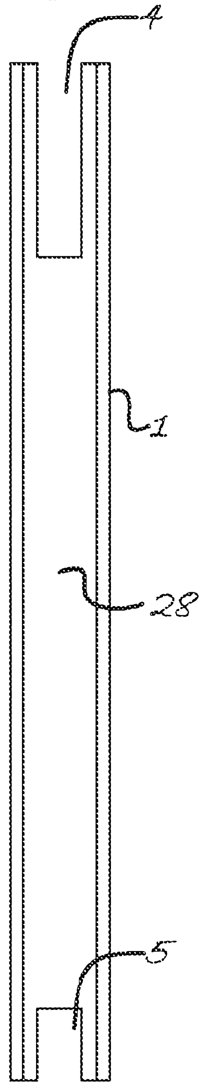

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Fig. 2a

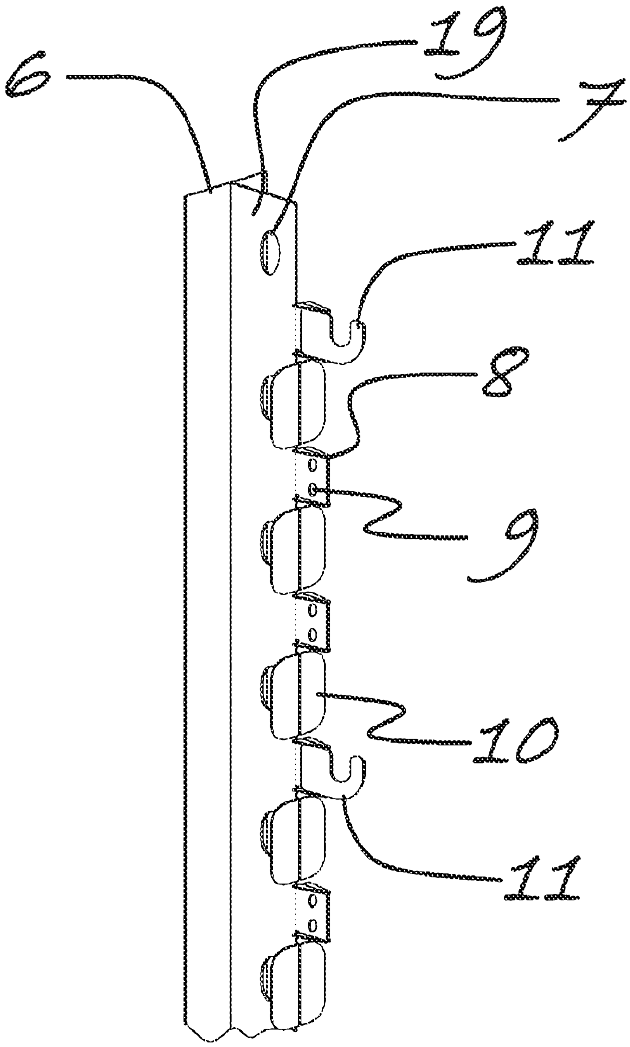

Fig. 2b

Top View:

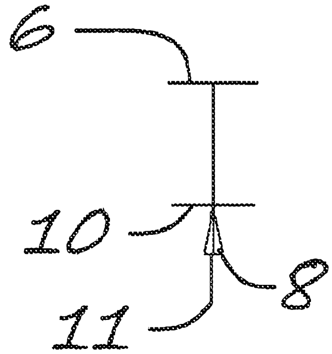

Fig. 3

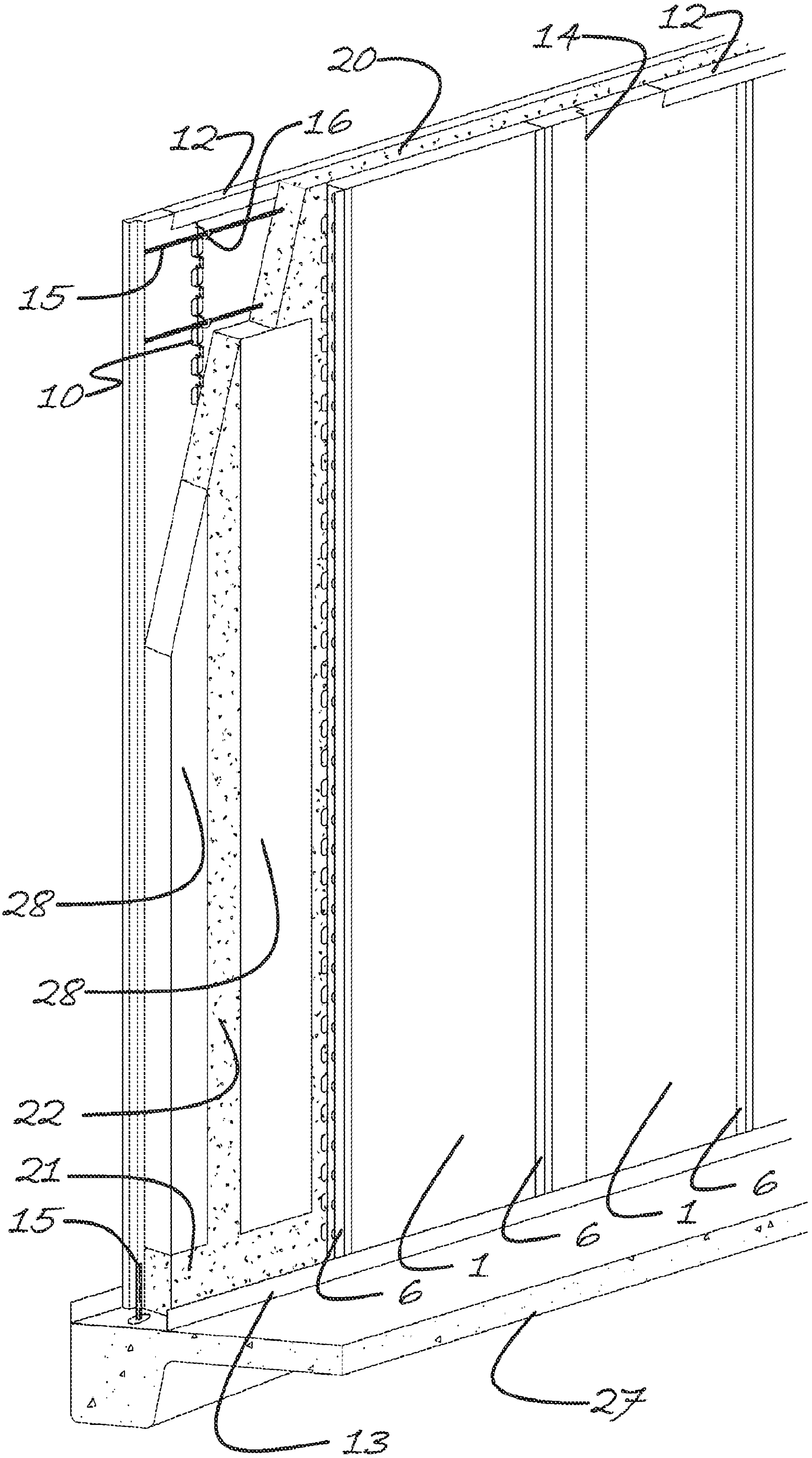

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Fig. 4

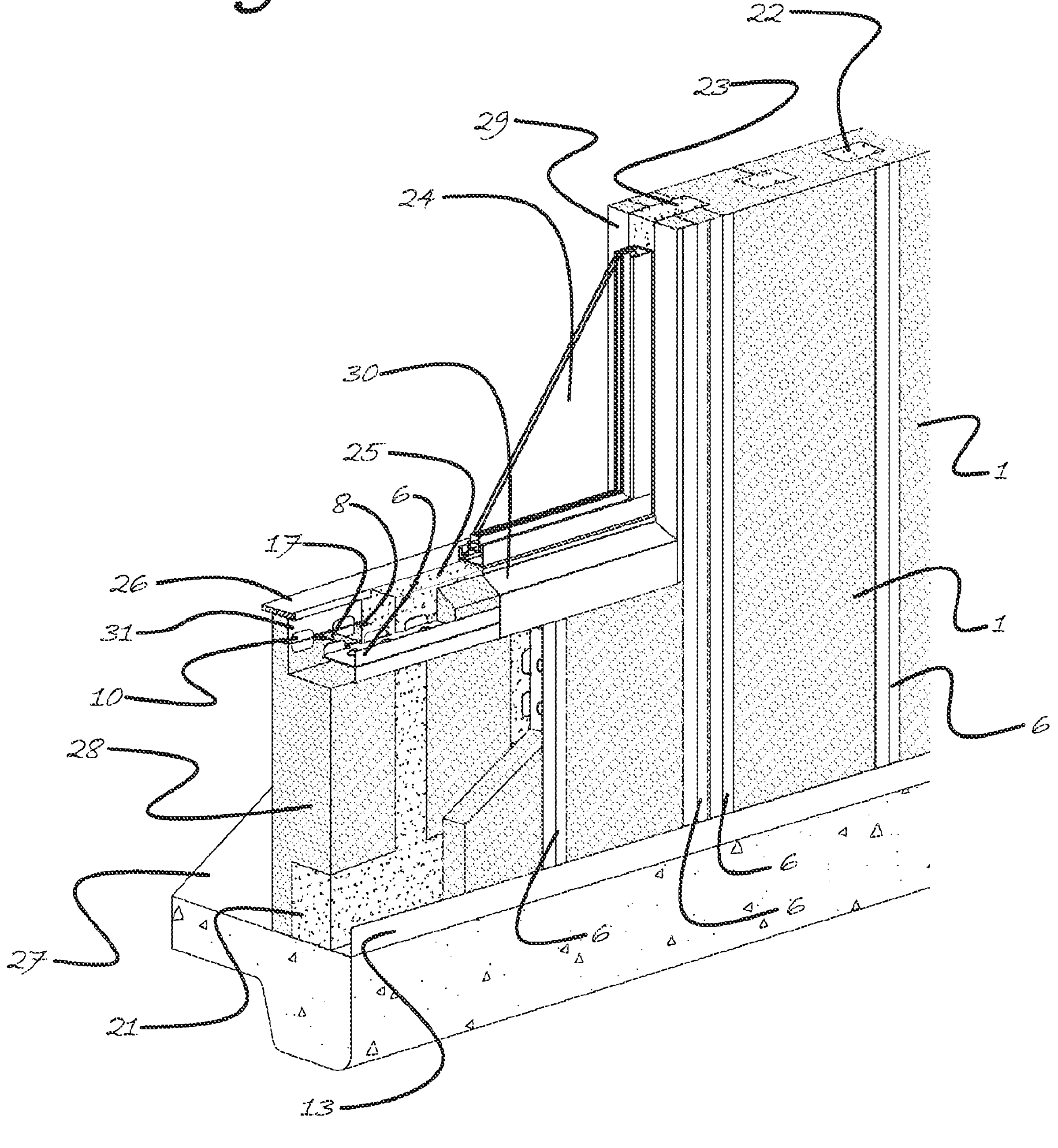

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Fig. 5

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