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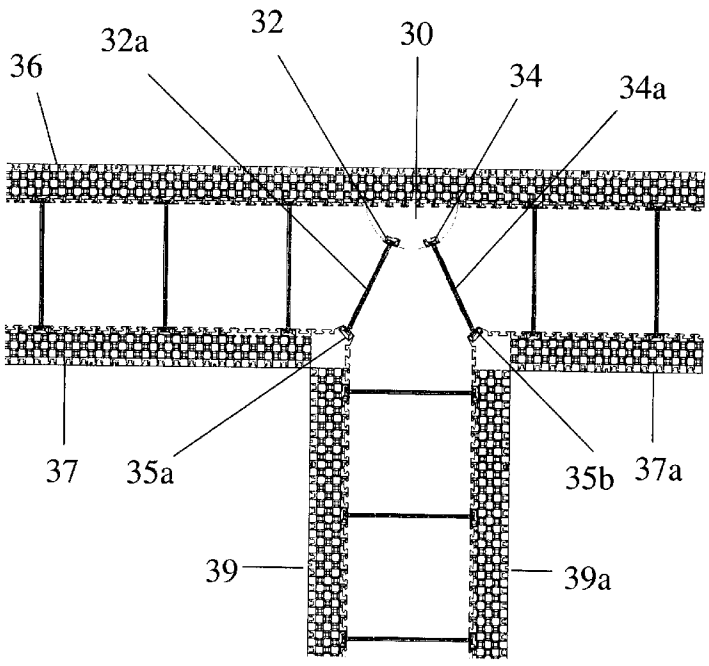

(57) Abstract: An insulated concrete form (ICF) panel reinforcement is disclosed. The ICF comprises a main panel, a reinforcement on the main panel for stiffening the main panel, a spacer retention element integrated in the reinforcement for securing a spacer to the panel, and a first opposing panel opposite the main panel and having a first opposing spacer retention element integrated therein for securing the spacer to the first opposing panel. The ICF panel reinforcement is particularly useful at high stress locations in ICF systems, such as at T-wall intersections.

WO 2008/009103 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INSULATED CONCRETE FORM PANEL REINFORCEMENT

FIELD OF THE INVENTION

The present invention relates generally to insulated concrete wall forms. More particularly, the present invention relates to a reinforcement for a panel or block in an insulated concrete form system.

BACKGROUND OF THE INVENTION

Insulated concrete forms (ICFs) are used in the construction of insulated concrete walls in a variety of building applications. In a system of ICFs, a series of opposing panels or pre-assembled block are separated, preferably by a distance equal to the thickness of the desired concrete wall, thus providing a channel, wall or column cavity into which concrete is poured. A typical ICF can comprise a pre-assembled block and/or one or more outside or main panels, and one or more inside or opposing panels across the wall cavity. Each panel usually has an exterior surface and an interior surface. In contrast to the exterior surfaces which generally do not oppose or connect with any other panels in the ICF, the interior surfaces of the main and opposing panels abut the concrete wall once concrete has been poured into the wall cavity. The panels are typically left permanently in place to serve as thermal or acoustic insulation, to provide space for running electrical wiring & plumbing, and as backing for gypsum boards, stucco, brick, or other siding on both the inside or outside of the panels or pre-assembled block.

The panels in an ICF system are often made of foam insulation or some other durable insulating or composite materials (foam, cement, wood chips/saw dust, plastics) or such as expanded polystyrene. Because of the flexibility required for diverse applications, lightweight panels that can be easily transported to the job site in sections are most desirable. Panel sections can be secured together using ties or braces, or can slide together in a lock-and-key, tab-and-slot, dovetail, tongue-and-groove or other interlocking arrangements with respectively interlocking members (see, for example, US Patent No. 5,428,933, issued July 4, 1995 to Philippe and incorporated herein by reference, which describes flipable, reversible and/or bi-directional panels having an interlocking

arrangement therein). The panels can be flat (yielding an even surface of concrete throughout the walls) or shaped, such as in a waffle or grid, where the concrete is thicker in some sections than others within the wall.

In typical ICF systems and other concrete form systems, fixed spacing between the interior surfaces of opposing panels is achieved with braces, form ties, brackets and/or spacers which hold the panels in place and support them relative to one another while concrete is poured in the wall cavity therebetween. Spacers can be attached to each panel in a variety of ways. As one example, a bracket holding a spacer is slid over the top edge of the each panel, such that a bracket holding the spacer is situated on both the interior and exterior surfaces of the panel. In other systems, a spacer is secured to a panel by passing the spacer through the panel and secured on the exterior surface by a retaining means (such as a nut, clamp, or the like). Alternatively, spacers can be attached to panels using the same tongue-and-groove assembly as described above.

Because of increased pressure at vulnerable locations in the panels along the length of an ICF system, additional bracing must be provided to the panels to prevent shifting, bulging or blowing out of the panels when the concrete is poured. These vulnerable locations can include corners (at the terminal junction of two intersecting walls), at the terminal junction of one (main) wall intersecting generally perpendicularly with another wall (i.e., at a "T-wall" intersection), or in the preparation of columns. Therefore, there has been a need to protect these vulnerable wall locations during concrete pouring operations in ICF systems.

Methods and apparatuses for supporting corner wall panels in ICF systems and other concrete wall forms are known in the prior art. These include US 4,180,956, issued Jan. 1, 1980 to Gross; US Patent No. 5,658,483, issued Aug. 19, 1997 to Boeshart; US Patent No. 5,896,714, issued April 27, 1999 to Cymbala et al.; US Patent No. 6,318,040, issued Nov. 20, 2001 to Moore; US Patent No. 6,324,804, issued Dec. 4, 2001 to Hoogstraten; US Patent No. 6,363,683, issued Apr. 2, 2002 to Moore; US Patent No. 6,419,205, issued July 16, 2002 to Meendering; US Patent No. 6,691,481, issued Feb. 17, 2004 to Schmidt; US Patent No. 6,519,906, issued Feb. 18, 2003 to Yost et al.; US Patent Application No. 2004/0020160, published Feb. 5, 2004 in the name of Durocher; US Patent No. 6,820,384, issued Nov. 23, 2004 to Pfeiffer; US Patent No. 5,390,459, issued

Feb. 21, 1995 to Mensen; and US Patent No. 5,704,180, issued Jan. 6, 1998 to Boeck. In many of these support designs, braces are added to the interior or exterior surfaces of corner/wall panels after installation of the panels in the concrete form at the job site. Brace assemblies, consisting of one or more braces attached together to form a matrix, can be pre-fabricated and inserted within the corner panel section. However, a previously-prepared assembly is not usually practical because of increased labour, variations in the wall heights and sizes and/or angles at corners throughout the ICF system. It is often necessary to custom build a brace support as the needs arise.

The support of T-walls or column is less well known in the prior art, and especially not in ICF systems. Typically, additional spacers are added around the T-wall/column intersection. However, traditional spacers which are used in other locations in the ICF system may not be particularly suitable at locations of high vulnerability, such as at the T-wall intersection.

US Patent No. 6,837,473, issued Jan. 4, 2005 to Petkau, describes a tie-rod assembly for connecting opposite wall formations in a regular concrete form. In T-wall (branch wall) formations, tie-rods which are much longer than rods used in regular panel support are inserted through the opposing walls around the T-wall intersection. As shown in Figure 11 of Petkau, braces are used to support the rods on the exterior surfaces of the panels.

T-wall assemblies for use in ICF systems are described in product manuals, such as from Quad-Lock building systems (http://quad-lock.com, Quad-Lock Building Systems, 7398 - 132nd St., Surrey, BC V3W 4M7 Canada). In this assembly, inside corner brackets connect the interior main wall panels to the inside panels of the intersecting T-wall. To support the intersecting panels to the opposite panels on the main wall, overlapping exterior corner brackets that span the concrete cavity between opposing panels are added. Alternatively, an exterior corner bracket is cut and placed on the outer wall panel. Ties are added to connect the outer panels with the inner panels, particularly at the junction of the inside main wall and intersecting wall, with the main panels. Additional flanges are required to support the outer panels. In the absence of two corner brackets, bracing is required to support the back side of the T-wall.

Additional spacers alone may not be sufficient to prevent blow-out at T-wall intersections. The absence of a wall directly opposing the main wall at the point of intersection is one reason why adequately supporting the T-wall has been challenging, since it is more difficult to add spacers to maintain the fixed spacing between the main panel and the opposing panels of the intersecting T-wall. Because of the increased vulnerability of the main wall panel to increased stress, the panel itself must be reinforced. The addition of a plate or other stiffening material to the panel at the intersection may serve to strengthen the panel. More often, buttresses or other supporting means are added to reinforce the main panel on its exterior surface.

US Patent Application No. 2004/0040240 to Patz et al. describes the erecting and support of T-walls in ICF systems. At the T-wall intersection, an inside T-wall plate is placed on the top edge each of the panels and an outside T-wall plate is placed on top of a second panel opposite the first panel. Ties are used to hold the panels together. The ties are perpendicular to each of the panels of the T-intersection. The plates are required to hold the panels together and to provide a means for attaching the linking ties between opposing panels. The plates are only secured to the top of the panels, leaving the bulk of the panel vulnerable to stress. Further, the spacers only connect opposing panels; there is no indication that the highly-vulnerable location on the panel directly opposite the T-wall intersection is protected.

US Patent No. 6,250,024, issued June 26, 2001 to Sculthorpe et al., describes a system for temporarily bracing an ICF that includes a bracing member, an anchoring member and a tensioning member, such as a flexible strap that is connected between the bracing member and the anchoring bar. The bracing member is required for maintaining a fixed distance between the panels in the ICF system during concrete pouring. However, openings in the form are required to permit passing of the strap through and around the anchoring bar. This can compromise the integrity of the form, leading to an infiltration of unwanted moisture and dust and potential form failure.

In the Nudura T-form system (http://www.nudura.com; Nudura Corporation, 27 Hooper Rd., Unit #10, Barrie, Ontario, Canada), T-walls are supported using standard brackets which connect the main panel with opposing panels, and connect the intersecting panels (across a channel between intersecting walls). An inward-projecting (i.e., toward

the intersection) block is situated on the main wall to help reinforce the panel at the T-wall intersection; however, no additional supporting means are used specifically at the T-wall intersection.

US Patent No. 4,916,879, issued April 17, 1990 to Boeshart, describes a T-wall reinforcement system. However, that system requires braces on both the interior surface of the panels as well as the exterior surface, and only connects to the top of the panel.

There have existed several problems with existing methods of protecting vulnerable locations in an ICF system from blow-out. While the installation of additional supports at these vulnerable locations has sought to reduce the incidence of blow-out by supplementing already-existing braces and/or spacers which keep opposing panels in place, merely adding additional supports may not necessarily prevent blow-outs if the supports are not properly positioned at the vulnerable location. For example, bowing and/or buckling of the panel at its mid-section can occur if spacers are added only at the top or bottom of a panel (such as through the use of brackets or plates which hook over the edge of a panel). In addition, prior T-wall assemblies have only protected opposing panels, without protecting or supporting the highly-vulnerable location on the main panel directly opposite the end of the intersecting panel(s). Further, if the brackets are not properly secured to the panel, either due to poorly-fitting brackets/spacers or because of a lack of sufficient time at the job site to properly retrofit the panels, the spacers may become disengaged from supporting brackets, or disassemble from the panel altogether. Ultimately, the spacers may only serve to hold the panels at a fixed distance from each other, rather than adding any additional stabilization. This lack of stabilization increases the risk of blow-out which can result in unnecessary and costly delays to the project.

In addition, the spacers themselves may not be suitable or structurally adequate to cope with increased pressure at the vulnerable locations. It may be necessary to install many different types of spacers throughout the ICF system to accommodate varying pressure sensitivities. Selecting the right spacer at the right location can be a challenge and inconvenient. If an improper spacer is chosen, there may still be an increased risk of blow-out regardless of any added support.

Attempts to reinforce or stabilize the T-wall or column by buttressing the exterior side of the main panel can be challenging. One problem with these exterior supports is

that their installation at the job site can add a considerable amount of time to perform a particular task, as it requires the builder to interrupt or delay the pouring of concrete within the form until the extra buttresses are added. Further, the buttresses are most ideally anchored to the ground or to another fixed location at a distance from the main wall. The absence of sufficient space to anchor the buttress to the ground or a sufficiently sturdy location renders their placement more difficult, particularly in multi-level construction.

It is desirable, therefore, to provide a practical and efficient means for both supporting opposing panels and reinforcing those locations in ICF systems that are particularly vulnerable to blow-out, such as on the main panel at a T-wall junction or in column forms.

SUMMARY OF THE INVENTION

It is an object of the present invention to obviate or mitigate at least one disadvantage of previous ICF panels, pre-assembled blocks and systems.

In a first aspect, the present invention provides an insulated concrete form comprising a main panel, a first opposing panel opposite the main panel, a spacer having first and second ends for maintaining a fixed spacing between the main panel and the first opposing panel, a reinforcement on the main panel for stiffening the main panel, a spacer retention element integrated in the reinforcement for securing the first end of the spacer to the main panel, and a first opposing spacer retention element in the first opposing panel for securing the second end of the spacer to the first opposing panel. The reinforcement can have one or more than one spacer retention elements.

The ICF can further comprise a second opposing panel opposite the main panel and first opposing panel, and having a second opposing spacer retention element integrated therein for securing a second spacer to a second spacer retention element in the reinforcement on the main panel. The second spacer maintains a fixed distance between the second opposing panel and the main panel. At the ends of each of the opposing panels can be attached intersecting panels, such that the intersecting panels are connected to each other by a spacer attached to intersecting spacer retention elements in the intersecting panels. A system comprising the opposing panels connected to the reinforced main panel

and the intersecting panels produces a reinforced T-wall or column insulated concrete form.

Surprisingly, the combination of a panel reinforcement with an integrated spacer retention element was found to add additional support in locations which are highly vulnerable to blow-out (such as at T-wall intersections). Using the reinforcement of the present invention on a main panel directly opposite the intersecting panel opposing panels in the ICF system can be connected by spacers in the usual manner while at the same time stiffening the main panel. The reinforcement is sufficiently sized so that it can protect the entire length of the panel, from top to bottom, when connected to the panel, and not merely at point locations in the panel. Further, the reinforcement can be used with opposing panels which are offset by differing heights or widths, or which face each other at different angles.

Advantageously, the reinforcement of the present invention can be readily retrofitted to any ICF panel, including those panels which are flipable, reversible and bi-directional. With panels having a dovetailed arrangement, or other interlocking elements, on their surface, a reinforcement can be manufactured to slide into the complementary interlocking elements on the panel, greatly facilitating the addition of reinforcements at the job site. However, any means for connecting the reinforcement to the panel can be used, such as with adhesives or the like. Alternatively, the reinforcements can be integrally manufactured in pre-fabricated ICF panels or a pre-assembled block.

As a further advantage, a panel having a reinforcement connected thereto in accordance with the present invention can be used anywhere in an ICF system, and in particular at locations having a high vulnerability for blow-out, without requiring additional supports or reinforcements as commonly used in previous ICF systems known in the art.

The reinforcement can be made of any suitable material, such as polystyrene or polyurethane foam, plastics, wood, or metal, and can include additional materials such as composite materials, filament tape or fibreglass or steel mesh. The reinforcement can also have a cavity therein for receiving and running electrical or plumbing components therethrough.

In another aspect of the present invention there is provided an insulated concrete form kit comprising a panel, a reinforcement for connecting to and stiffening the panel and comprising a spacer retention element integrated therein, and a spacer having first and second ends, the first end for securing to the spacer retention element, and the second end for securing to an opposite panel in the insulated concrete form.

In a further aspect, the present invention provides a concrete column form comprising one or more panels, each having a surface facing an interior of the column and a spacer retention element integrated in each surface, and a plurality of spacers each having first and second ends, the first end of the spacer for securing to the spacer retention element on the one or more panels, and the second end for connecting with the second end of an adjacent spacer in the interior of the column.

Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described, by way of example only, with reference to the attached Figures, wherein:

Fig. 1 shows a top view of a T-wall form in an ICF system.

Fig. 2 shows a different embodiment of the T-wall in a top projection.

Fig. 3 shows the T-wall embodiment of Fig. 2, in top angled projection.

Fig. 4 shows an embodiment of a three-sided form using a reinforcement of the present invention.

Fig. 5 shows a reinforcement in accordance with the present invention.

Fig. 6 shows a reinforcement similar to the one in Fig. 5.

Fig. 7 shows a circular column form.

Fig. 8 shows a heptagonal column form.

Fig. 9 shows an embodiment of a corner form in accordance with the present invention.

DETAILED DESCRIPTION

Generally, the present invention provides an ICF system having a reinforcement at a T-wall intersection. More particularly, the present invention provides an insulated concrete form comprising a main panel, a first opposing panel opposite the main panel, a spacer having first and second ends for maintaining a fixed spacing between the main panel and the first opposing panel, a reinforcement on the main panel for stiffening the main panel, a spacer retention element integrated in the reinforcement for securing the first end of the spacer to the main panel, and a first opposing spacer retention element in the first opposing panel for securing the second end of the spacer to the first opposing panel.

A panel having a reinforcement connected thereto in an ICF according to the present invention is referred to herein as a reinforced panel. The reinforced panel can be used at any location along an ICF system. The reinforced panel is particularly suitable at locations vulnerable to high stress and blow-outs when concrete is poured in the form, such as at T-wall intersections or corners (which may or may not be at a right angle). The reinforced panel can also be used in sections of the ICF system with offset opposing panels, where an opposing panel is not directly (i.e., perpendicularly) opposite but is, instead, at an angle away from the reinforced panel, or where opposing panels are of different heights or widths.

Any ICF panel can be a reinforced panel for use in the system of the present invention. Exemplary panels are described in U.S. Patent No. 5,428,933, issued July 4, 1995, to Philippe and entitled "Insulating Construction Panel or Block" and incorporated herein by reference. The panels can be flipable, reversible and bi-directional. For example, the panels can be rotated horizontally, vertically, or both, depending on the orientation of the panel and the intended use. They can also be panels having a "universal fit"; this can mean that the panels have no predetermined top, bottom, left or right side. These panels can be made of durable materials commonly used by the skilled person in the manufacture of such panels. These materials can include, but are not limited to, polystyrene, polyurethane foam, or other polymer-based or composite materials.

The reinforced panel of the present invention can be prepared for use at a wide variety of locations in an ICF system. Because of this adaptability, there is no need to select specific panels at a given location in the ICF system.

Figure 1 illustrates one embodiment of T-wall form in an ICF system comprising a reinforced panel of the present invention. Between main panel 10 and opposing panel 12 is a channel 14 in which a material, such as concrete, is poured to make a structure of interest, such as a wall. In the exemplary embodiment shown in Figure 1, a reinforced panel is used at a T-wall intersection. Both the main panel 10 and opposing panel 12 abut a concrete wall formed when concrete is poured into the channel 14. At the T-wall, an intersecting channel 16 is shown. The intersecting channel 16 is formed between opposing intersecting panels 18 and 19. Each intersecting panel 18 and 19 can connect to one or more opposing panels 12 or 13 at a corner 22. The intersecting panels 18,19 can connect to opposing panels 12,13 through an attachment (e.g., tongue-and-groove or another linker, etc.); however, an intersecting panel and an opposing panel may be one integrated "L"-shaped panel.

As shown in Figure 1, panels used in the ICF of the present invention, such as main panel 10, comprise a reinforcement 20. The reinforcement stiffens the panels to prevent blow-out and/or other damage often caused by the pouring of concrete within the channel between the panels of the ICF system. Ideally, the reinforcement is placed on the main panel, such as on an interior surface of the main panel, such as directly opposite intersecting panels in a T-wall or corner intersection, where vulnerability for blow-out is highest.

The reinforcement 20 can be integral to the panel. An integral reinforcement 20 forms part of the panel during the manufacturing of the panel. The reinforcement can be made of any durable material, such as polystyrene or polyurethane foam. The reinforcement 20 can be made of the same durable material as the panel, which can be advantageous for reducing added costs and time associated with the manufacture of the panel. Depending on the desired thickness of the panel, the concrete wall, or the amount of stress expected at the particular location in the ICF system, the reinforcement 20 can be any size or shape, and can jut into the channel 14 any distance. In certain embodiments of the panel of the present invention, filament tape, fibreglass mesh or other reinforcing materials can be placed within the integrated reinforcement 20. These optional materials add extra stiffness to the panel as needed in a given ICF system.

The reinforcement of the present invention comprises one or more spacer retention elements. Exemplary spacer retention elements 23, 23a and 23b are shown. Spacer retention elements 23a,b receive and secure spacers 24a,b to the reinforcement 20 which in turn serve to connect and stabilize opposing panels in the ICF. As shown in Figure 1, main panel 10 has a reinforcement 20 connected thereto and having spacer retention elements 23a,b integrated within the reinforcement 20.

Spacer retention elements used in the present invention are typically made of a durable, yet flexible, material such as moulded plastic (e.g., high impact polystyrene). In reinforced panels comprising an integrated reinforcement, a spacer retention element can be inserted into a reinforcement prior to injection of the panel material (which, as mentioned, may be any durable material such as expanded polystyrene (EPS) foam, composite material or the like) during the manufacture of the panel. A spacer retention element is held in place in the reinforcement by the surrounding EPS. The use of a polystyrene spacer retention element is highly favourable for placement in EPS foam. Within the EPS are beads of material that, because of the compatibility of the EPS with the insert, fuse with the polystyrene spacer retention element. This creates a solid means for securing and reinforcing the panel, especially at high stress locations (such as at a T-wall junction). During formation of the reinforced panels of the present invention, spacer retention elements can be positioned in any orientation within EPS foam, i.e., they can be randomly distributed within the reinforced panel, or placed in particular positions as required for the particular use.

Spacer retention elements can be any shape for receiving a spacer. In some embodiments, the spacer retention element is a dovetail design having a groove therein. This design can be used for receiving and securing spacers, which can be slid into the groove. However, it will be appreciated that any spacer retention element may be used in the context of the present invention.

Spacer retention elements can also be angled within the reinforcement such that spacers secured thereto are also angled. The angle of the spacer retention elements within the reinforcement will vary depending on the concrete core thickness and, if used at T-wall junctions, the location of the corners of the intersecting wall. Spacer retention elements can be placed such that spacers secured thereto are at an angle of between 0 and 90° from

the panel. Optimally, this angle is 45° from the panel, although any suitable angle can be used. With spacers placed at an angle, a broader section of the panel (and panels opposite thereto, to which the spacer connects) can be reinforced.

As shown in Figure 1, main panel 10, opposing panels 12 and 13, and intersecting panels 18 and 19 comprise spacer retention elements. However, not all of the panels may have a reinforcement 20. In the example shown, main panel 10 has a reinforcement 20 with integrated spacer retention elements 23a,b. A panel may not have a spacer retention element integrated in a reinforcement. In panels of this sort, the spacer retention element may be integrated directly into the interior surface of the panel itself. However, In the context of the present invention, an "opposing panel" (ie., opposite the main panel) can be any component of an ICF which has a spacer retention element therein and can secure a spacer for maintaining a distance between a main panel and the opposing panel. Thus, a spacer retention element can include, for example, retention elements in a side of the opposing panel facing the interior of the concrete channel, at an end of the opposing panel, or in any component, attachment or adaptor added and secured to the opposing panel which is suitable for retaining the spacer. ICF panels having spacers connecting opposing panels via spacer retention elements which are not integrated in a reinforcement may be more vulnerable to blow-out during concrete pouring. However, it may not be necessary for every panel in an ICF system to have a reinforcement therein or connected thereto. As mentioned above, the reinforced panel is particularly suitable for use at high stress locations in an ICF system where blow-out is more likely to occur, such as, for example, directly opposite the ends of intersecting panels at a T-wall intersection.

Spacers 24 and 24a-c are used to space apart opposing wall panels, such as main panel 10 and opposing panel 12, or intersecting panels 18 and 19. Any spacer can be used as appropriate for maintaining a fixed distance between the interior surfaces of opposing panels in an ICF system. Like the spacer retention element and reinforcement, a spacer can be made of any durable and flexible material. The spacer can also be adaptable and adjustable in length, size and shape for accommodating narrower or wider channels, formed between opposing panels. Spacers particularly suitable for use in the present invention have enough flexibility and tolerances to accommodate offset insertions at

varying locations, such as at T-wall intersections which may or may not be exactly perpendicular to the main panel.

Locking spacers, such as those described in US Design Patent No. 435,212, can be used to assist in the reinforcement of the form to prevent compaction, floatation or blow-out. Spacers of this sort can slide into each other (such as on top of each other) or can be separated into two locking spacers as required. The spacers can then lock into the spacer retention elements on the panel and become "trapped" when pressure from poured concrete or slurry is applied. Locking spacers reinforce the panel vertically and horizontally by locking and holding the panels of the form tightly in place as the channel in the form is being filled with concrete. This helps to minimize or prevent movement of the panels in the form and maintaining a uniform distribution of pressure from the poured concrete.

Figure 1 shows the placement of spacers 24 and 24a-c connecting main panel 10 to opposing panels 12 and 13, and intersecting panels 18 and 19. In the exemplary T-wall shown in Figure 1, spacers 24a, 24b are secured to spacer retention elements 23a,b in a reinforcement 20 on main panel 10, and to spacer retention elements 23c,d at the junctions of opposing panels 12,13 and intersecting panels 18,19, respectively. In this orientation, pressure is directed to the reinforcement 20 on main panel 10. With the addition of spacer 24c between opposing intersecting panels 18 and 19, the three spacers 24a-c form a triangular reinforcement area. The triangulation, comprising the combination of a reinforcement and integrated spacer retention element, adds support to the vulnerable T-wall intersection and reduces the likelihood of blow-out when concrete is poured.

Figures 2 and 3 show additional embodiments of the ICF system of the present invention. The reinforcement is a modular reinforcement 30 which is connected to a panel 36 in the ICF. As with the integrated reinforcement, any number of modular reinforcements 30 can be added at any location in the ICF system. Ideally, the modular reinforcement 30 is suited for use at locations having an increased risk for blow-out, such as at a T-wall intersection, corners or column forms. Also consistent with the integrated reinforcement, the modular reinforcement 30 has one or more spacer retention elements integrated therein. As shown in the exemplary embodiment of Figure 2, modular reinforcement 30 comprises two spacer retention elements 32 and 34; however, any

number of spacer retention elements may be integrated in a modular reinforcement. The modular reinforcement 30 can be connected in any way to the main panel, such as at the surface of panel 36, and can extend, as shown more particularly in Figure 3, from the top to the bottom of the panel (or beyond, in the case of offsetting panels) to enhance the coverage of reinforcement. In panels having a tongue-and-groove (tab-and-slot) or dovetail interface, such as that shown in Figures 2 and 3, the modular reinforcement 30 can be manufactured with complementary interlocking elements such that the reinforcement slides into the interior surfaces of the panels. Alternatively, the reinforcement can be bonded with compatible glues at any desired location on the panel. In either case, the reinforcement should be sufficiently strong and durable to resist any hydrostatic pressure from the poured concrete.

In Figure 2, spacers 32a and 34a are secured to spacer retention elements 32 and 34, respectively, within reinforcement 30, and to spacer retention elements 35a,b, respectively, at the junction of panels 37 and 39 and at the junction of panels 37a and 39a.

Figure 4 shows another embodiment of an ICF which may incorporate the reinforcement of the present invention. In this exemplary form, main panel 36 opposes and is connected to three-sided panel 88. The three-sided panel 88 comprises opposing panel 37 (such as the panel illustrated in Fig. 2), side panel 92 and third panel 90. Reinforcement 80 is shown with an additional spacer retention element 82, in which spacer 84 connects with third panel 90. Spacer 32a connects the reinforcement 80 to the corner spacer retention element 94 of the three-sided panel 88. As with the spacers described herein, spacer 84 can be adjustable in length to accommodate a wide range of distances spanning the channel between main panel 36 and opposing panel(s).

Figure 5 shows one embodiment of a modular reinforcement of the present invention. Modular reinforcement 40 can be any shape. In the embodiments shown, the modular reinforcement 40 has a semi-circular or half-moon shape. A flat edge 42 of the modular reinforcement 40 connects with a panel, such as panel 36 in Figures 2 to 4. In the exemplary embodiment shown in Figure 5, the modular reinforcement 40 is attachable to a panel by sliding dovetail segments 46 into corresponding grooves on the panel (not shown). An arcuate portion 38 of the modular reinforcement 40 extends into a channel between the interior surfaces of opposing panels. The modular reinforcement 40 shown in

Figure 5 contains two spacer retention elements 44 and 45. Spacers (not shown) can be slid into the spacer retention elements 44 and 45, as described above.

Figure 6 shows a different embodiment of the modular reinforcement which can be used in the ICF system of the present invention. The modular reinforcement 50 can attach to a panel in a manner similar to that shown in Figure 3 or can be glued at any location within the assembly. In this exemplary embodiment, no spacers are required. Instead, modular reinforcement 50 has a hollow interior cavity 52 which can act as a buffer between the poured concrete and the panel to which the modular reinforcement 50 is attached. The cavity 52 is suitable for passing materials therethrough, such as plumbing or wiring, before or after the concrete wall has been completed. However, it would be appreciated by the person of skill in the art that spacers may be incorporated into the modular reinforcement as appropriate.

In another aspect of the present invention there is provided an insulated concrete form kit comprising a panel, a reinforcement for connecting to and stiffening the panel, the reinforcement comprising a spacer retention element integrated therein, and a spacer having first and second ends, the first end for securing to the spacer retention element, and the second end for securing to an opposite panel in the insulated concrete form. The kit is particularly useful for assembling an ICF on the job site and can also be advantageous in situations where additional reinforced panels are required.

In another aspect of the present invention there is provided a insulated concrete column form comprising one or more panels, each having a surface facing an interior of the column and a spacer retention element integrated in each surface, and a plurality of spacers each having first and second ends, the first end of the spacer for securing to the spacer retention element on the one or more panels, and the second end for connecting with the second end of an adjacent spacer in the interior of the column. Columns can be pre-fabricated or manufactured on a job site. In either case, the columns can comprise one or more of the reinforced panels as described herein, particularly if shapes other than circular columns are desired. A column may be incorporated into an ICF wall assembly, combined with another column, or be a stand-alone column for decorative purposes.

Figures 7 and 8 show different embodiments of the columns which can be used in the present invention. Figure 7 shows a circular column. The column form panel 60

illustrated in this exemplary embodiment is a singly-constructed circular panel. The column form panel 60 can be made of the same durable material as other panels used in the present invention. The column form panel 60 may have one or more spacer retention elements 62, either attached to the column form panel 60 at a construction site or integrated within the column form panel 60 when the panel is manufactured. Spacer 64 helps support the column form panel 60 when concrete is poured in the column channel 66. While any spacer known in the art can be used, it would be particularly advantageous to use a spacer having interconnecting spacer clips 68. These spacer clips 68 permit a plurality of spacers 64 to link together and add further stability to the column form panel 60. For example, a spacer 64 can have a spacer clip 68 which permits the connection of two spacers 64a,64b, one on either side of the spacer. An additional tie wrap or band (not shown) can be added around the interconnected spacer clips 68 to provide additional reinforcement to the column form spacer 60. As with other embodiments of the present invention, such as those exemplified herein, filament tape, fibreglass mesh or other reinforcing materials can also be placed within the column form 60.

In the embodiment shown in Figure 7, the spacer clips 68 interconnect such that a cavity 69 is formed. This cavity 69 permits utilities (such as electrical cables, mechanical devices or ductwork, for example) to be passed therethrough. Further, a second ("double") column can be positioned within the cavity 69, if desired.

Figure 8 shows an example of an insulated concrete column form which is not a true circle. Non-circular column forms, such as the exemplary heptagonal form 70 shown in Figure 8, can be manufactured as a one-piece form, or can comprise a plurality of panels 72 which are combined to produce the heptagonal column form 70. As with the circular column form in Figure 7, the heptagonal form 70 can have one or more spacer retention elements 74, either attached to or integrated in each panel 72. Spacers 76 having interconnecting spacer clips 78 can be used to form cavity 79. The spacers 76, spacer clips 78, and cavity 79 have been described above.

Figure 9 shows another embodiment of the present invention, as used in a corner. As mentioned herein, corners (i.e., at a terminal intersection of one panel against another panel, for example) are also highly vulnerable to blow-out. In the exemplary embodiment of the present invention shown, a corner reinforcement 90 can be inserted at the junction

of two intersecting panels 92 and 93. The intersecting panels can intersect at any angle, but are often perpendicular (i.e., at or about 90°) to each other. Further, the intersecting panels may or may not abut each other; they may be connected merely via the corner reinforcement connected to each of the intersecting panels, or some other means to connect the panels as would be known in the art. The corner reinforcement 90 can be attached to the panels by any means, such as through the use of complementary interlocking elements whereby the reinforcement slides into the interior surfaces of the panels. Alternatively, the reinforcement can be bonded with compatible glues, or other suitable attachment means. Spacers 94a and 94b connect the corner reinforcement 90 with opposing panels 95 and 96 across channel 97. Similar to the exemplary T-wall and offsetting wall embodiments shown in Figures 1 to 4, the spacers can connect to the opposing panels at one or more corner retention elements 98. The corner retention elements 98 can be in a side of the opposing panel facing the interior of the channel, at an end of the opposing panel, or in any component, attachment or adaptor added and secured to the opposing panel which is suitable for retaining the spacer. Thus, the "opposing panel" in the context of the present invention can be any component of an ICF which has a spacer retention element therein and can secure a spacer for maintaining a distance between a reinforcement in or on the main panel and the opposing panel. In addition, any suitable spacer can be used, including spacers which are adjustable and adaptable to different widths across the channel 97.

The above-described embodiments of the present invention are intended to be examples only. Alterations, modifications and variations may be effected to the particular embodiments by those of skill in the art without departing from the scope of the invention, which is defined solely by the claims appended hereto.

What is claimed is:

1. An insulated concrete form comprising:

a main panel,

a first opposing panel opposite the main panel,

a spacer having first and second ends for maintaining a fixed spacing between the main panel and the first opposing panel,

a reinforcement on the main panel for stiffening the main panel,

a spacer retention element integrated in the reinforcement for securing the first end of the spacer to the main panel, and

a first opposing spacer retention element in the first opposing panel for securing the second end of the spacer to the first opposing panel.

2. The insulated concrete form of claim 1 wherein the reinforcement comprises a plurality of the spacer retention elements integrated therein.

3. The insulated concrete form of claim 2 further comprising a second opposing panel opposite the main panel and first opposing panel, and having a second opposing spacer retention element integrated therein for securing a second spacer to a second spacer retention element in the reinforcement on the main panel, wherein the second spacer maintains a fixed distance between the second opposing panel and the main panel.

4. The insulated concrete form of claim 3 wherein an end of the first opposing panel is attached to an end of a first intersecting panel, and an end of the second opposing panel is attached to an end of a second intersecting panel, such that the first and second intersecting panels are connected to each other by a spacer attached to intersecting spacer retention elements in the intersecting panels.

5. The insulated concrete form of claim 4 wherein the main panel, the opposing panels and the intersecting panels are connected to produce a T-wall insulated concrete form.

6. The insulated concrete form of claim 1 wherein the reinforcement is integral to the main panel.

7. The insulated concrete form of claim 1 wherein the reinforcement is a reinforced material.

8. The insulated concrete form of claim 7 wherein the reinforced material is a composite material, a polymer or a polymer-based compound.

9. The insulated concrete form of claim 8 wherein the polymer is polystyrene or polyurethane foam.

10. The insulated concrete form of claim 9 wherein the reinforcement further comprises filament tape, fiberglass or steel mesh.

11. The insulated concrete form of any one of claims 1 to 5 wherein the main panel, the opposing panels and the intersecting panels are flipable, reversible and/or bi-directional.

12. An insulated concrete form panel comprising:

a reinforcement on the panel for stiffening the panel, and

a spacer retention element integrated in the reinforcement for securing a spacer thereto for connecting the panel to an opposing panel in the insulated concrete form.

13. The insulated concrete form panel of claim 12 wherein the reinforcement is integral to the panel.

14. A reinforcement for stiffening an insulated concrete form panel comprising:

a spacer retention element for securing a spacer thereto for connecting the panel to an opposing panel in the insulated concrete form, and

means for connecting the reinforcement to the panel.

15. The reinforcement of claim 14 wherein the means for connecting the reinforcement to the panel comprises one or more interlocking elements which connect with complementary interlocking elements on the panel.

16. An insulated concrete form kit comprising:

a panel,

a reinforcement for connecting to and stiffening the panel,

a spacer retention element integrated in the reinforcement, and

a spacer having first and second ends, the first end for securing to the spacer retention element, and the second end for securing to an opposing panel in the insulated concrete form.

17. The kit of claim 16 wherein the panel is flipable, reversible and/or bi-directional.

18. A method of reinforcing a panel in an insulated concrete form comprising:

connecting to the panel a reinforcement having a first spacer retention element integrated in the reinforcement; and

securing a spacer to the first spacer retention element and to a second spacer retention element integrated in an opposing panel in the insulated concrete form,

such that the insulated concrete form panel is reinforced.

19. A insulated concrete column form comprising:

one or more panels, each having a surface facing an interior of the column and a spacer retention element integrated in each surface, and

a plurality of spacers each having first and second ends, the first end of the spacer for securing to the spacer retention element on the one or more panels, and the second end for connecting with the second end of an adjacent spacer in the interior of the column.

20. The insulated concrete column form of claim 19 wherein the one or more panels are flipable, reversible and/or bi-directional.

21. An insulated concrete form for a T-wall comprising:

a main panel,

a first opposing panel opposite the main panel

a spacer having first and second ends for maintaining a fixed spacing between the main panel and the first opposing panel,

a reinforcement on the main panel for stiffening the main panel,

a spacer retention element integrated in the reinforcement for securing the first end of the spacer to the main panel,

a first opposing spacer retention element in the first opposing panel for securing the second end of the spacer to the first opposing panel, and

a second opposing panel opposite the main panel and first opposing panel, and having a second opposing spacer retention element integrated therein for securing a second spacer to a second spacer retention element in the reinforcement on the main panel,

wherein an end of the first opposing panel is attached to an end of a first intersecting panel, and an end of the second opposing panel is attached to an end of a second intersecting panel, such that the first and second intersecting panels are connected to each other by a spacer attached to intersecting spacer retention elements in the intersecting panels, and

wherein the main panel, opposing panels and intersecting panels are connected to produce a T-wall form.

22. The insulated concrete form of claim 21 wherein the main panel, the opposing panels and the intersecting panels are flipable, reversible and/or bi-directional.

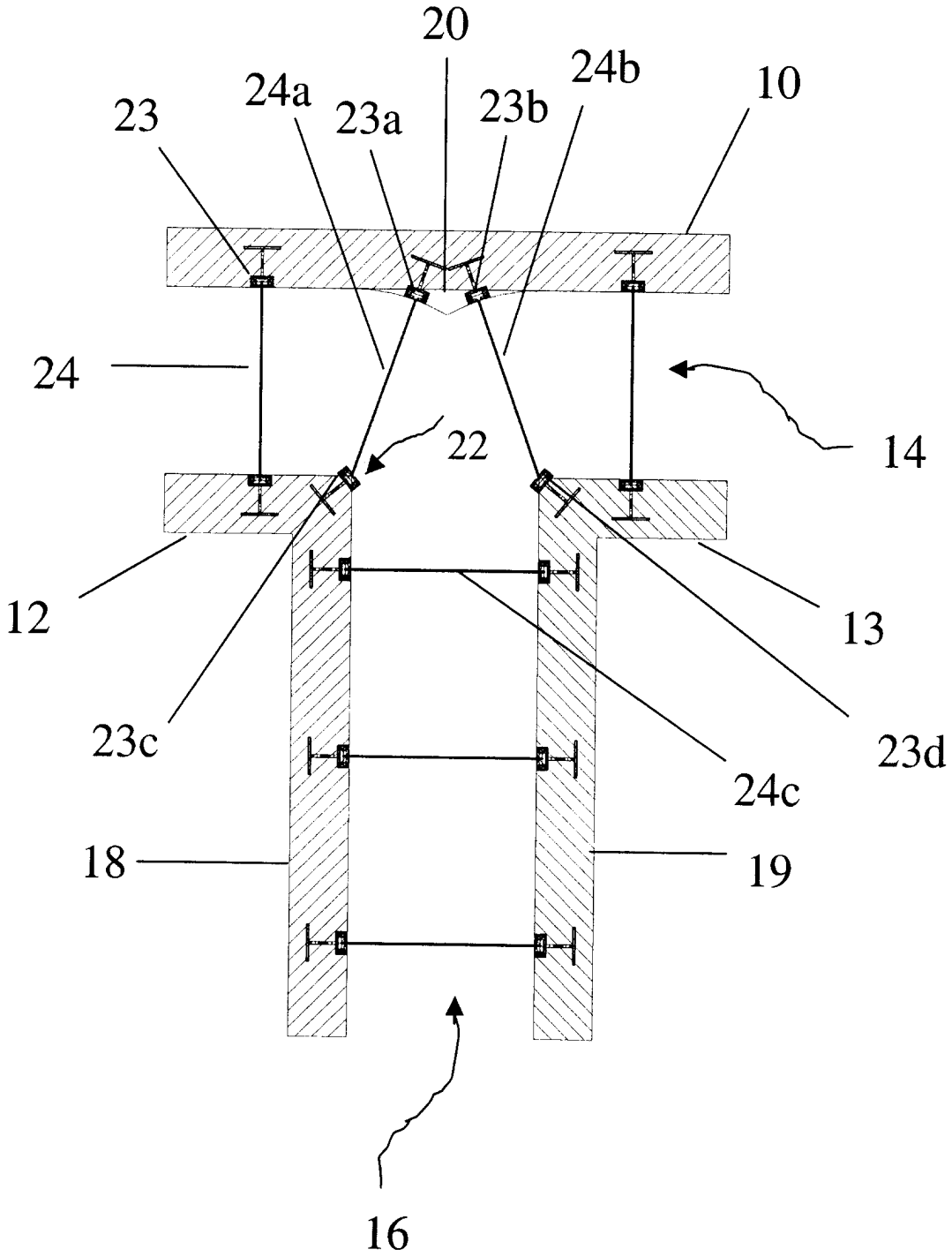

Figure 1

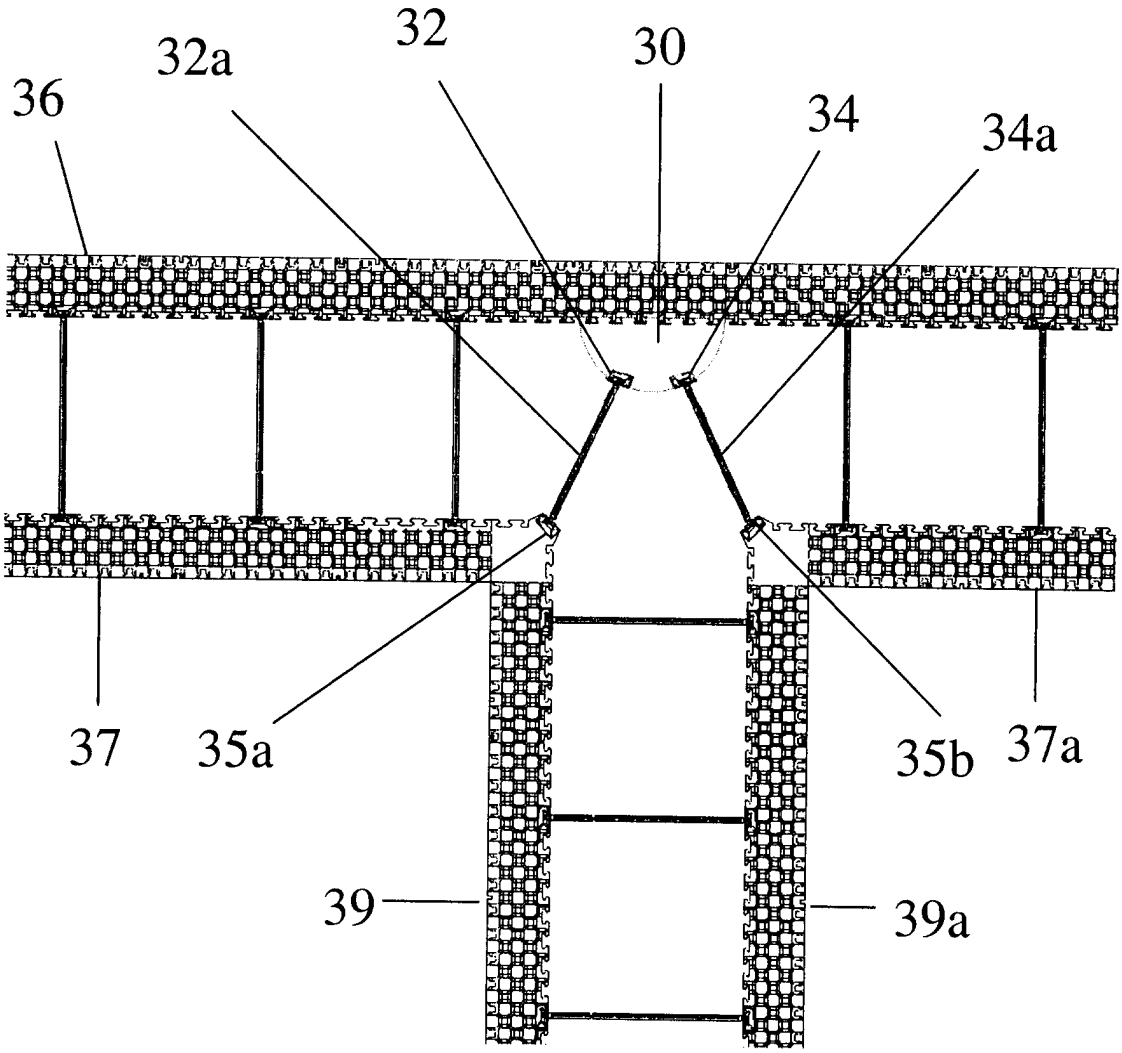

Figure 2

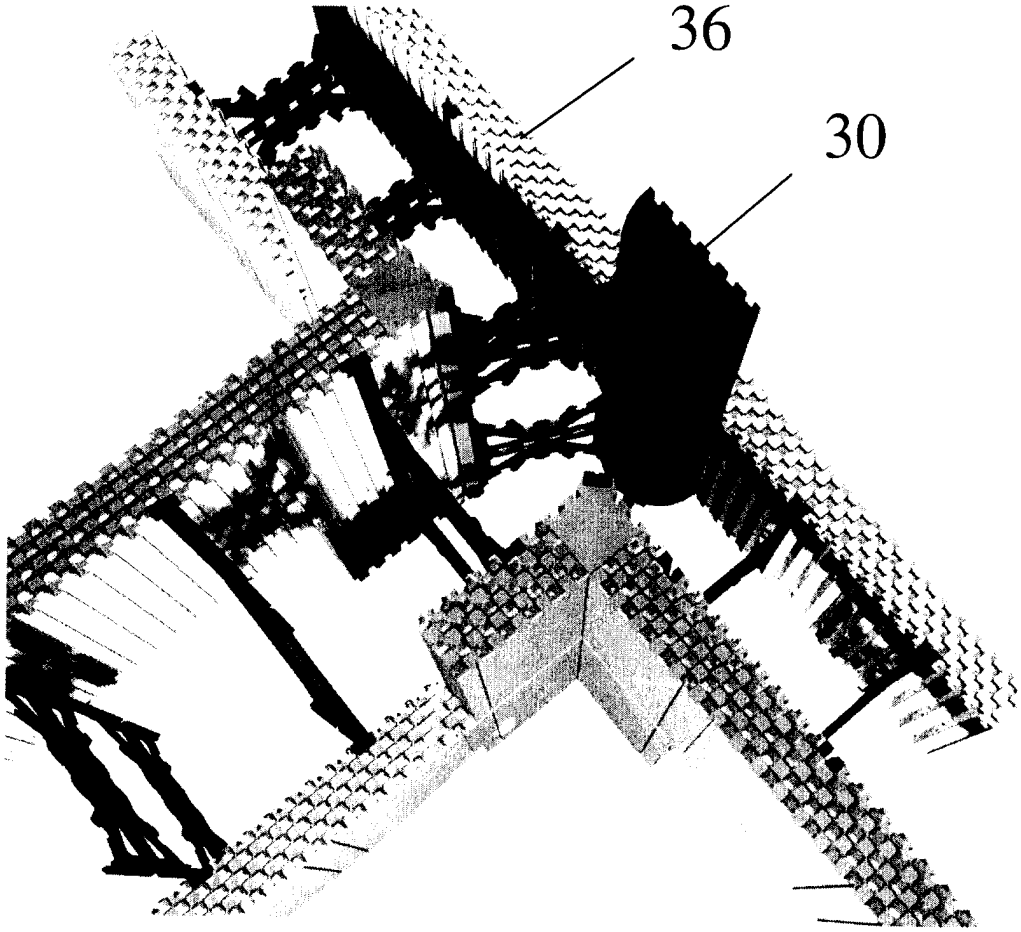

Figure 3

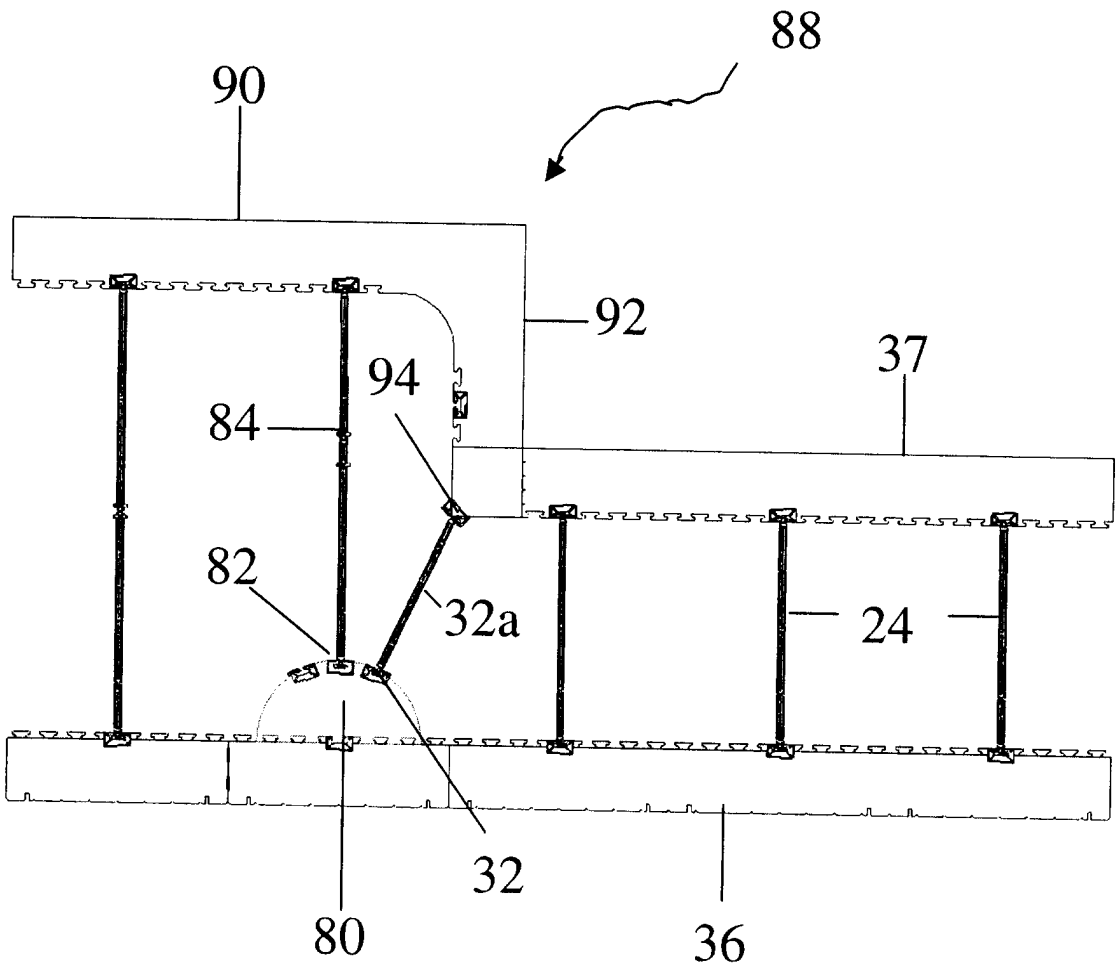

Figure 4

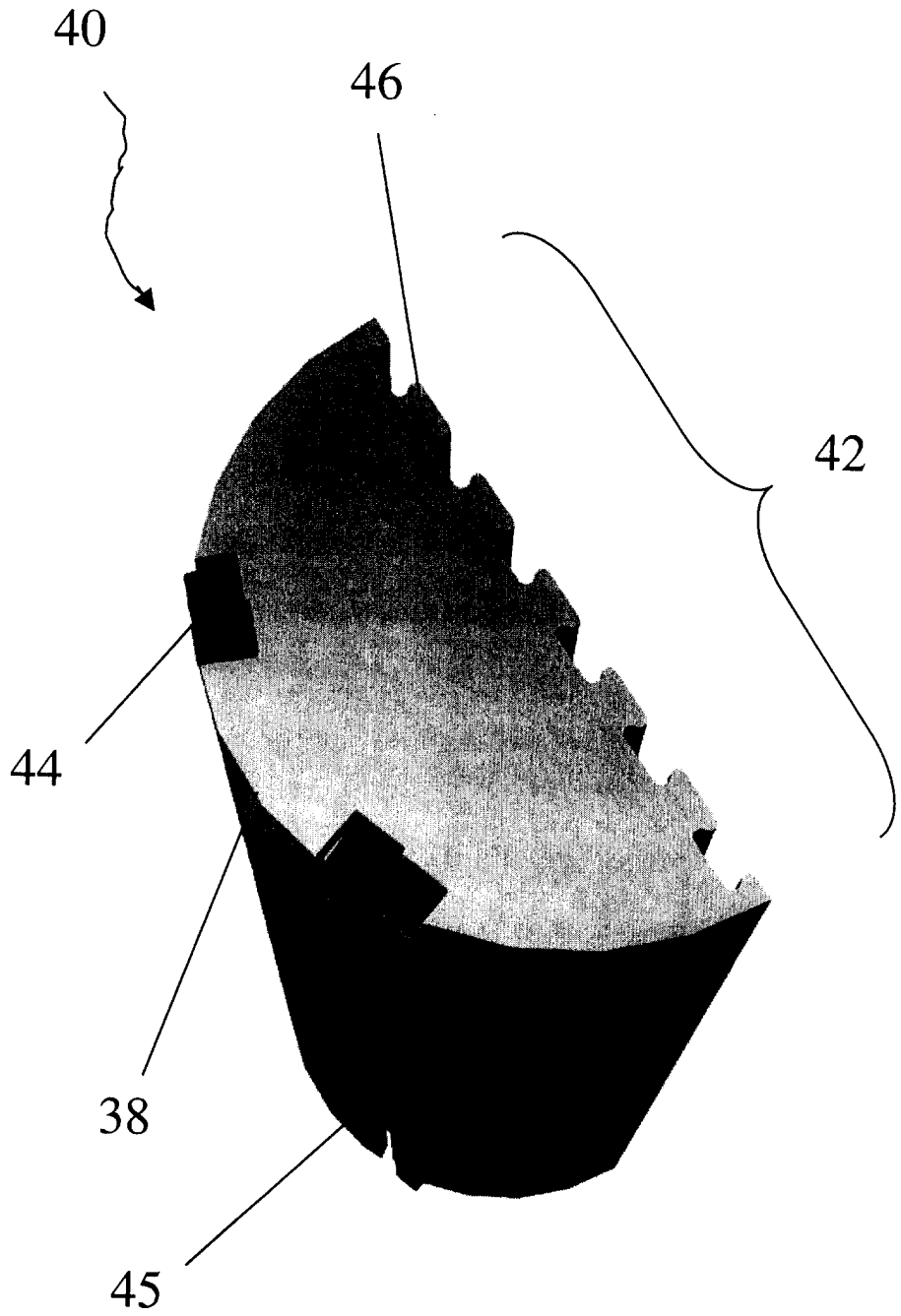

Figure 5

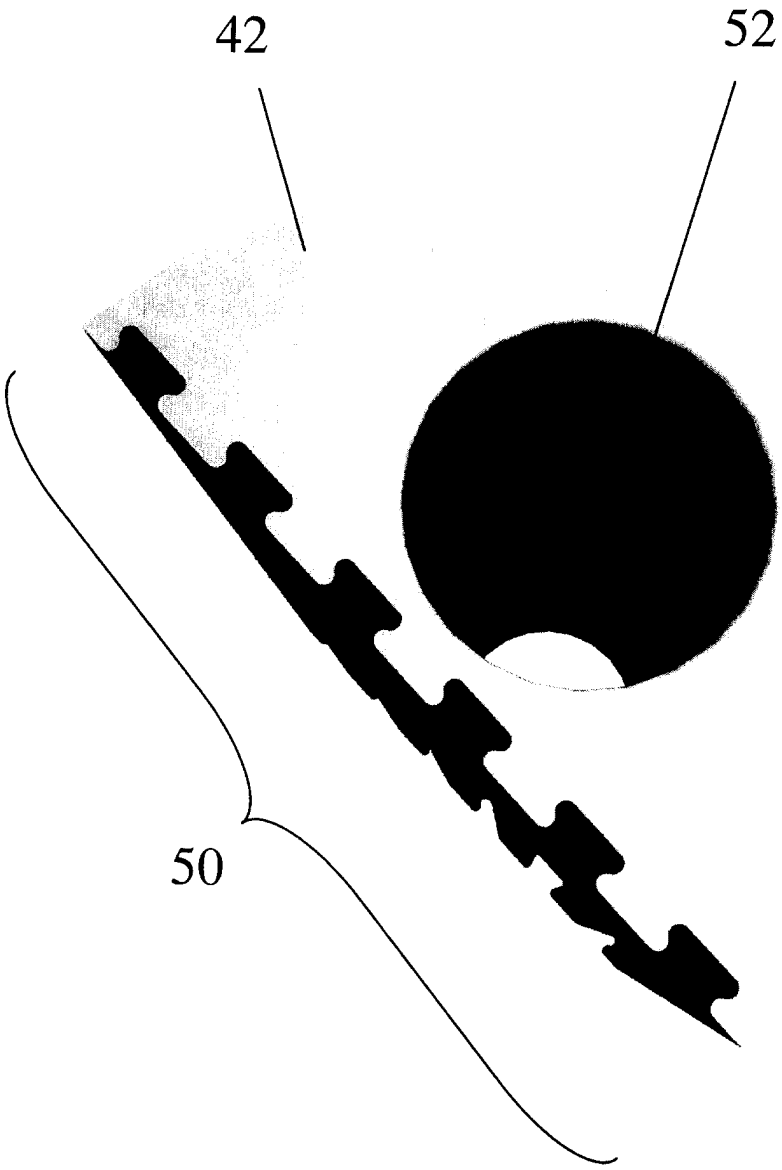

Figure 6

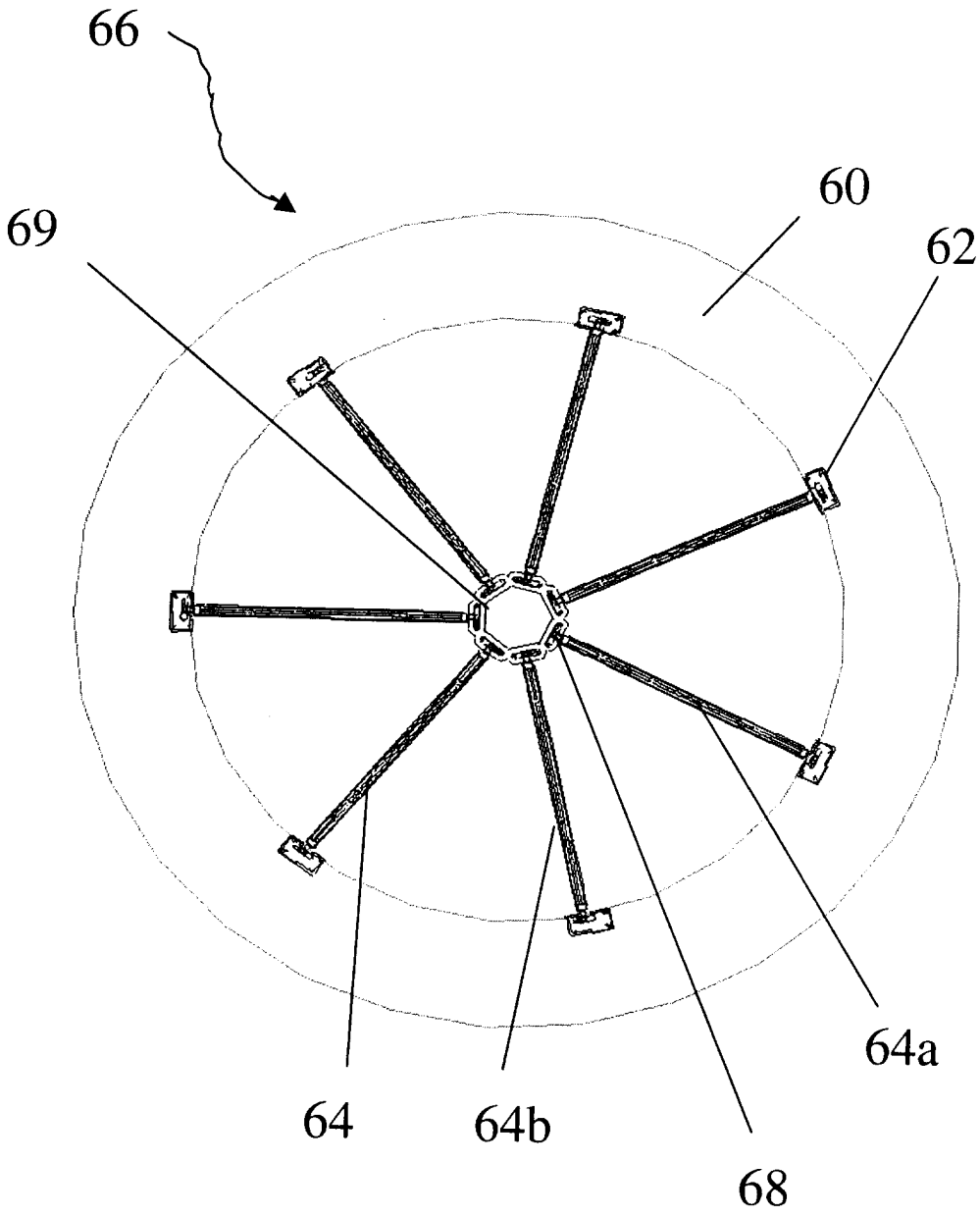

Figure 7

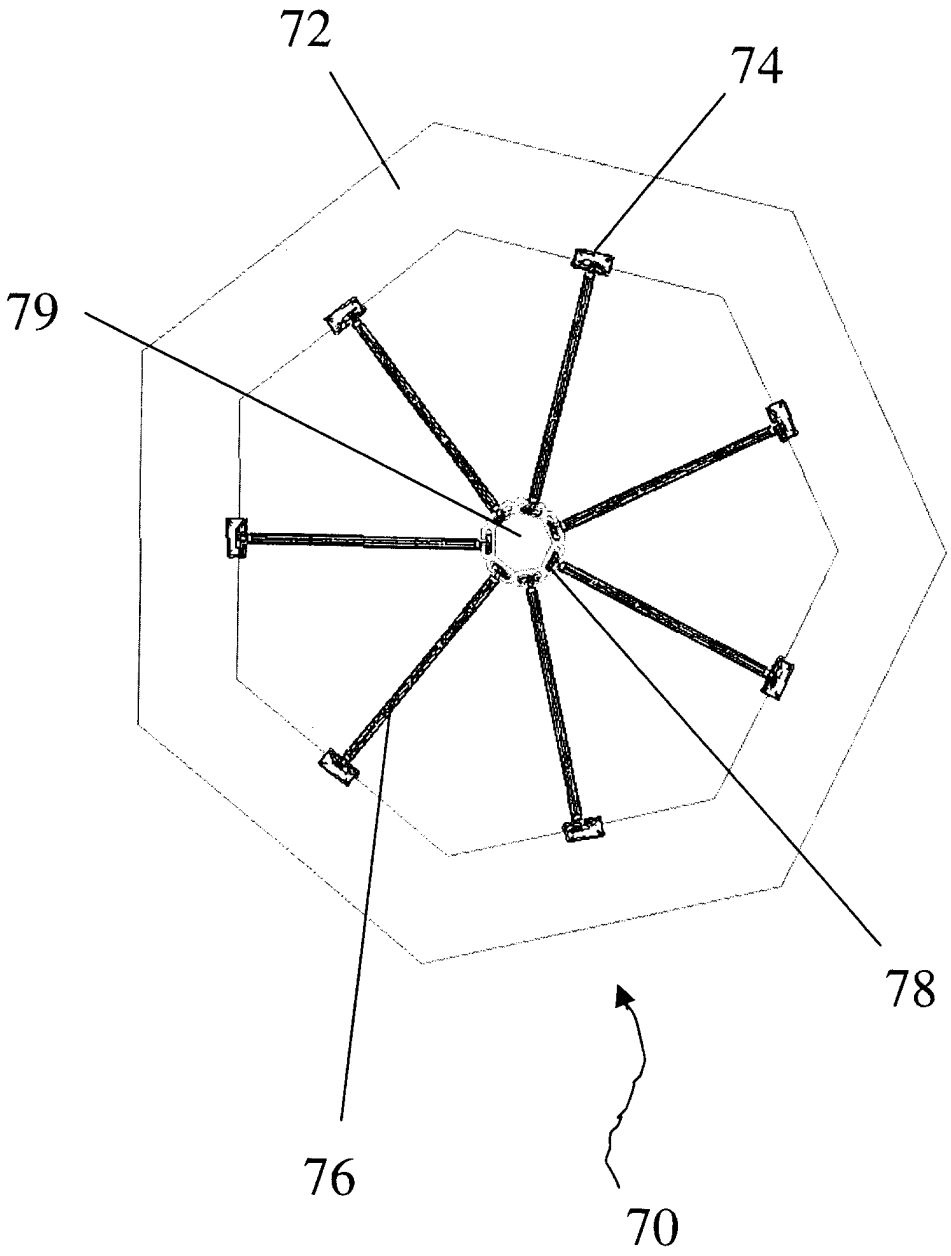

Figure 8

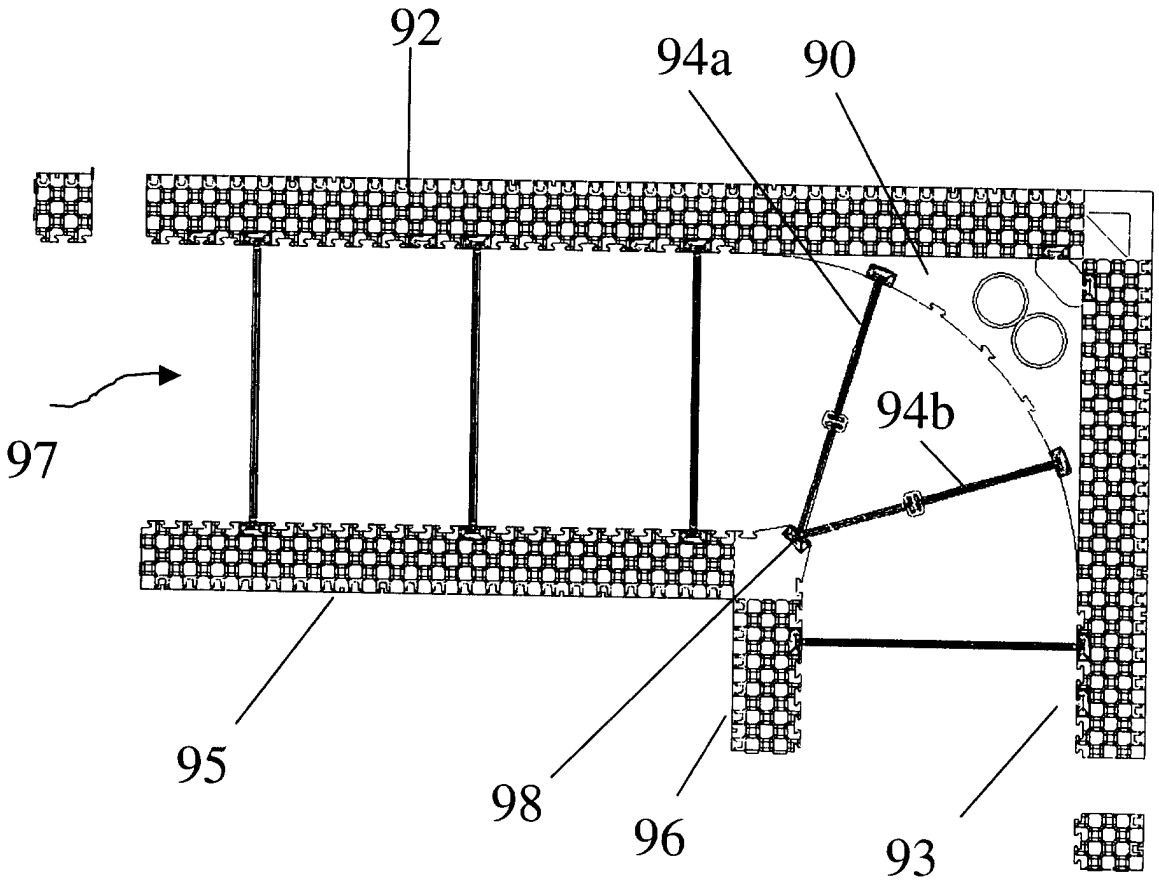

Figure 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2007/001240

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***E04B 2/86*** (2006.01) , ***E04B 2/54*** (2006.01) , ***E04G 11/06*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: E04B 2/86 (2007.01), E04B 2/54 (2007.01), E04B 2/40 (2007.01), E04G 11/06 (2007.01), E04C 1/41 (2007.01), E04G 13/02 (2007.01), E04C 3/30 (2007.01), E04C 3/34 (2007.01) USPC: 52/309.1-309.17,425-433,698-715; 249/48,49,51,737.1,737.2,189-196

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

Delphion, WEST, Canadian Patents Database

Keywords: reinforc*, stiff*, tie, spacer, brace, bridge, insulat*, column, pillar, pier, post, etc.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 20040040240 (PATZ et al.) 4 March 2004 (04-03-2004) - Figures 14 to 18 -	1-2, 7, 12, 14-16, 18, 21 3-5, 10-11, 17, 22
X Y	US 5809728 (TREMELLING) 22 September 1998 (22-09-1998) - Figures 26 and 31 -	1, 6-9, 12, 13 3-5, 10
Y	CA 2142517 (PHILIPPE) 15 August 1995 (15-08-1995) - The whole document -	11, 17, 22
A	US 4703602 (PARDO) 3 November 1987 (03-11-1987) - Figures 5 to 7 -	19, 20
A	US 5658483 (BOESHART) 19 August 1997 (19-08-1997) - The whole document -	1, 16, 18

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 September 2007 (26-09-2007)	24 October 2007 (24-10-2007)

Name and mailing address of the ISA/CA	Authorized officer
Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Jean-François Desrosiers 819- 934-6358

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, P	CA 2551250 (BELIVEAU) 18 May 2007 (18-05-2007) - The whole document -	1, 16, 18, 21
A	"Fastform Concrete Forming - Nudura Products - T Wall Form Unit" [online]. Fastform Concrete Forming [retrived on Sept. 14, 2007] Retrived from the Internet: <URL: http://www.fastform.ca/nudura.html> Date of written disclosure verified by the Internet Archive Wayback Machine < URL : http://web.archive.org> as being on or before Nov. 4, 2005.	1, 16, 18, 21
A	CA 1244668 (KRECKE) 15 November 1988 (15-11-1988) - The whole document -	1, 16, 18, 21
A	US 4949515 (KRECKE) 21 August 1990 (21-08-1990) - The whole document -	1, 16, 18, 21

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons :

1. [ ] Claim Nos. :
because they relate to subject matter not required to be searched by this Authority, namely :

2. [ ] Claim Nos. :
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically :

3. [ ] Claim Nos. :
because they are dependant claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows :

see extra sheet

1. [X] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos. :

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos. :

Remark on Protest
[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
[ ] No protest accompanied the payment of additional search fees.

The claims are directed to 2 inventions:

Group A: Claims 1-18 and 21-22 are directed to a reinforcement for use in an insulated concrete form.

Group B: Claims 19-20 are directed to an insulated concrete column form.

The claims of Groups A and B do not share a common inventive concept. The claims must be limited to one invention only as set out in PCT Rule 13.

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
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US 5658483A	19-08-1997		None
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