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Chin

(54) **WAFFLE BOX BUILDING TECHNOLOGY**

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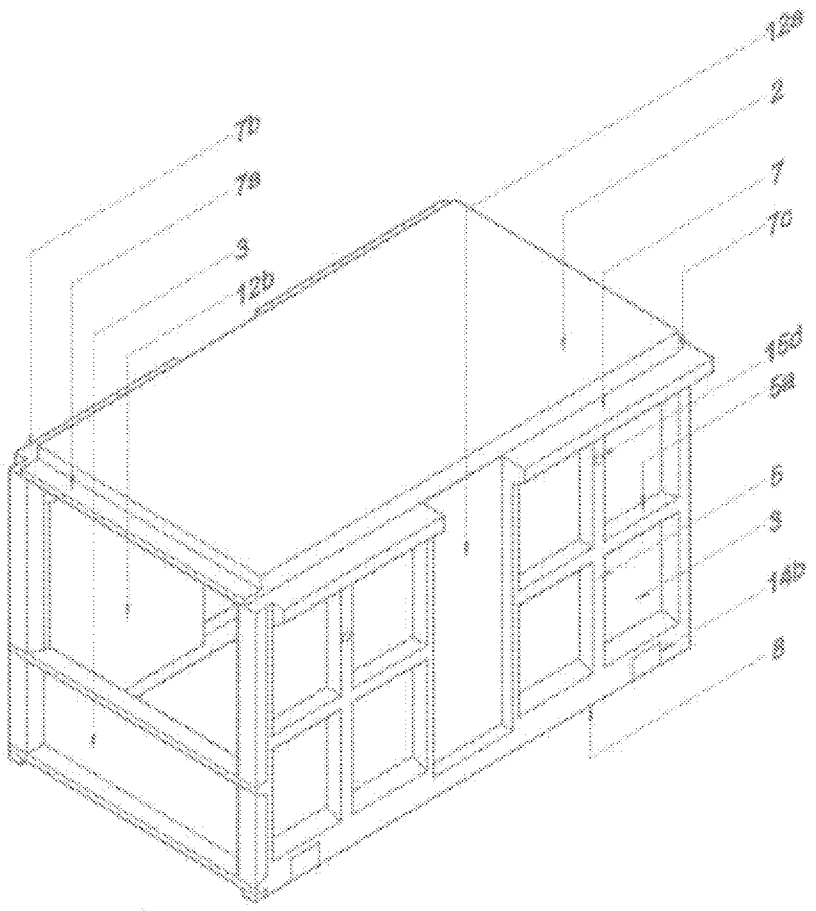
E04B 1/348	(2006.01)

(52) **U.S. Cl.**

CPC ... ***E04B 1/04*** (2013.01); ***E04B 1/61*** (2013.01); ***E04B 1/34807*** (2013.01); ***E04H 9/02*** (2013.01); ***E04H 9/14*** (2013.01); ***E04H 9/145*** (2013.01); ***E04H 9/16*** (2013.01); *E04B 2103/02* (2013.01); *E04B 2001/34389* (2013.01)

(57) **ABSTRACT**

The Waffle box is a process of installation of Type II waffle boxes placed alternately facing each other which is best for buildings with common corridors. The wings that serve as corridor, wall, window, are improvements from the prior arts. Being an alternative building system with thinner walls and slabs, lighter and cheaper but is equally stronger, fast, resilient, green, and sustainable. It is a process and a product that has less cost with more value added.



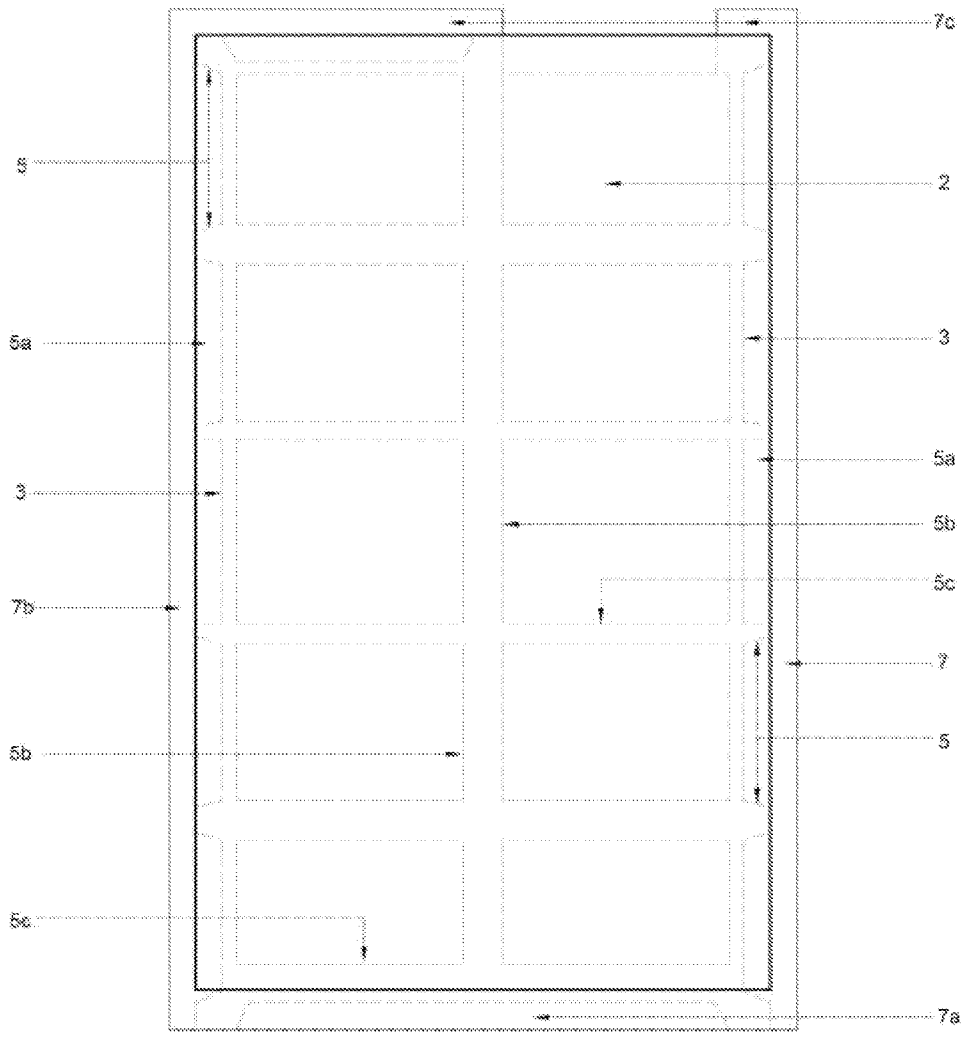


FIGURE 1

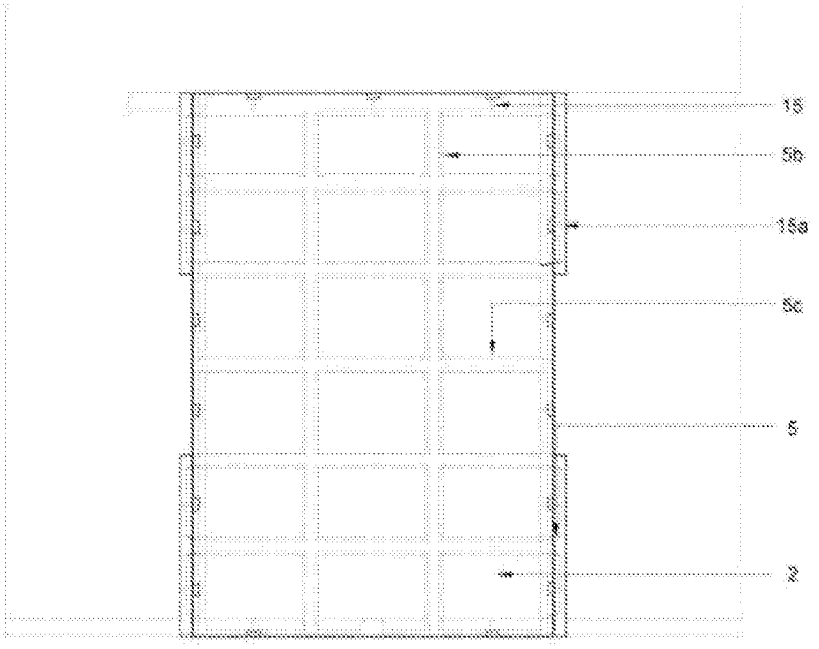


FIGURE 2b

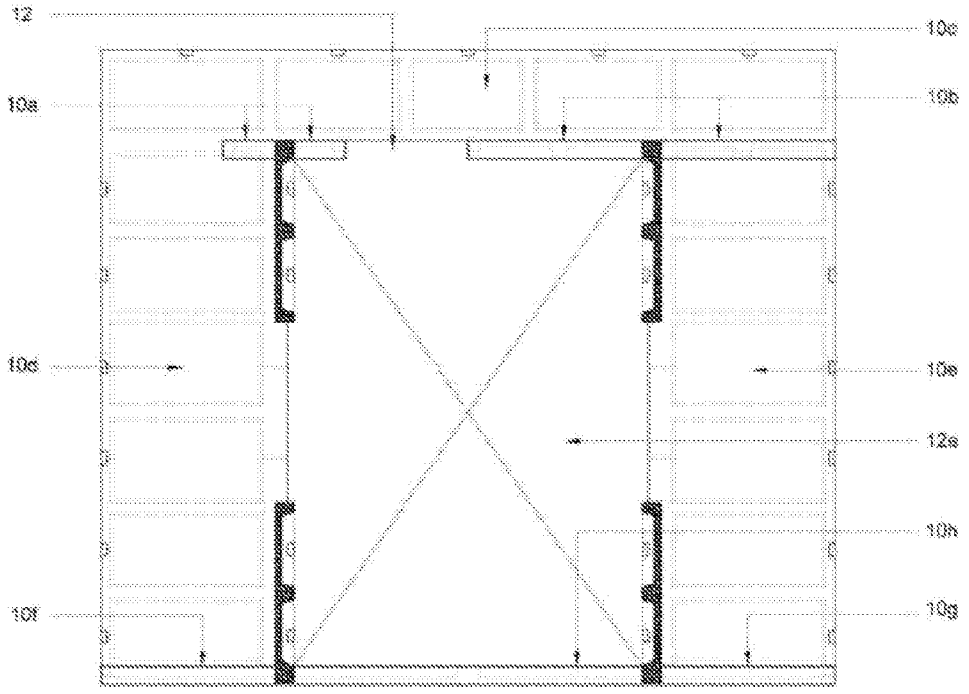


FIGURE 1a

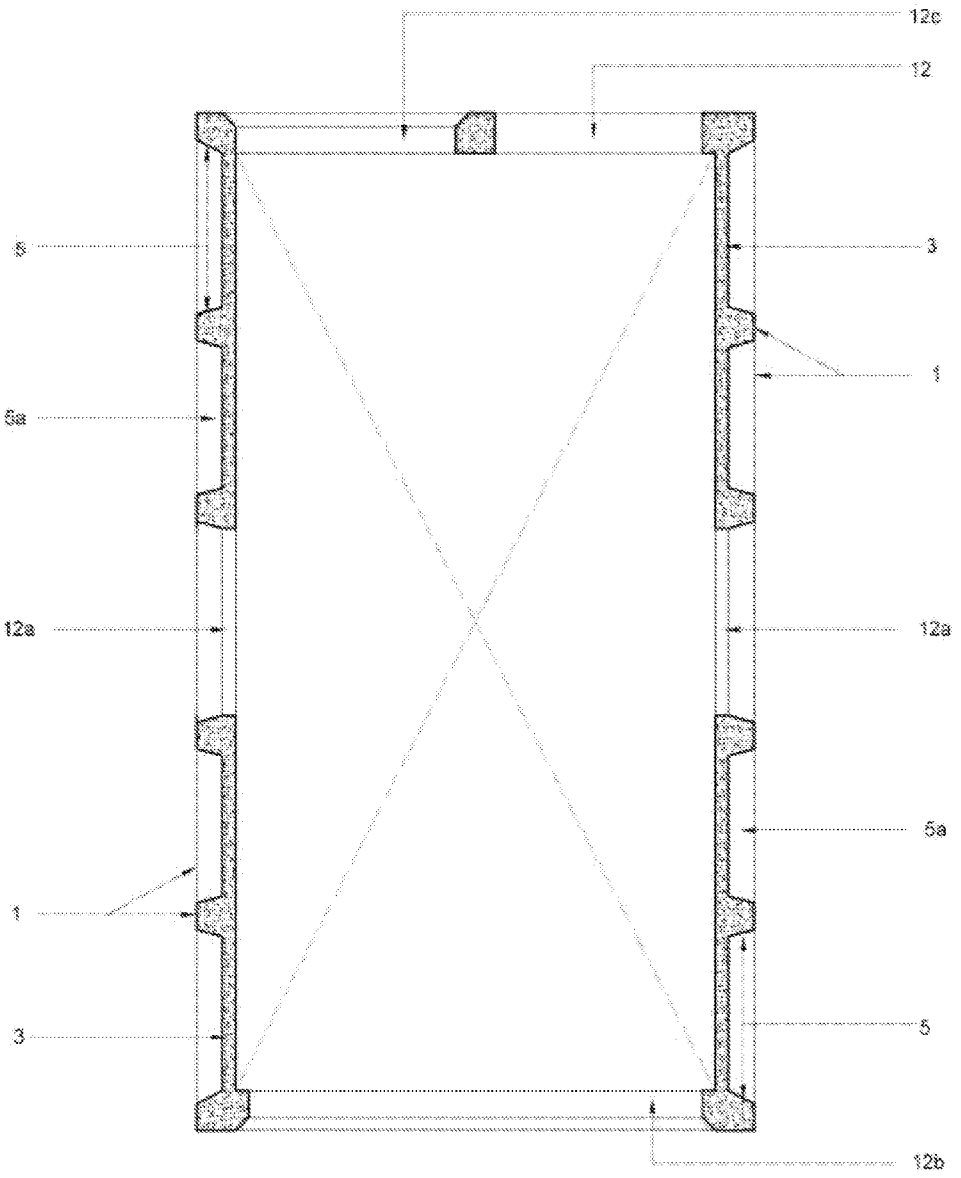


FIGURE 2

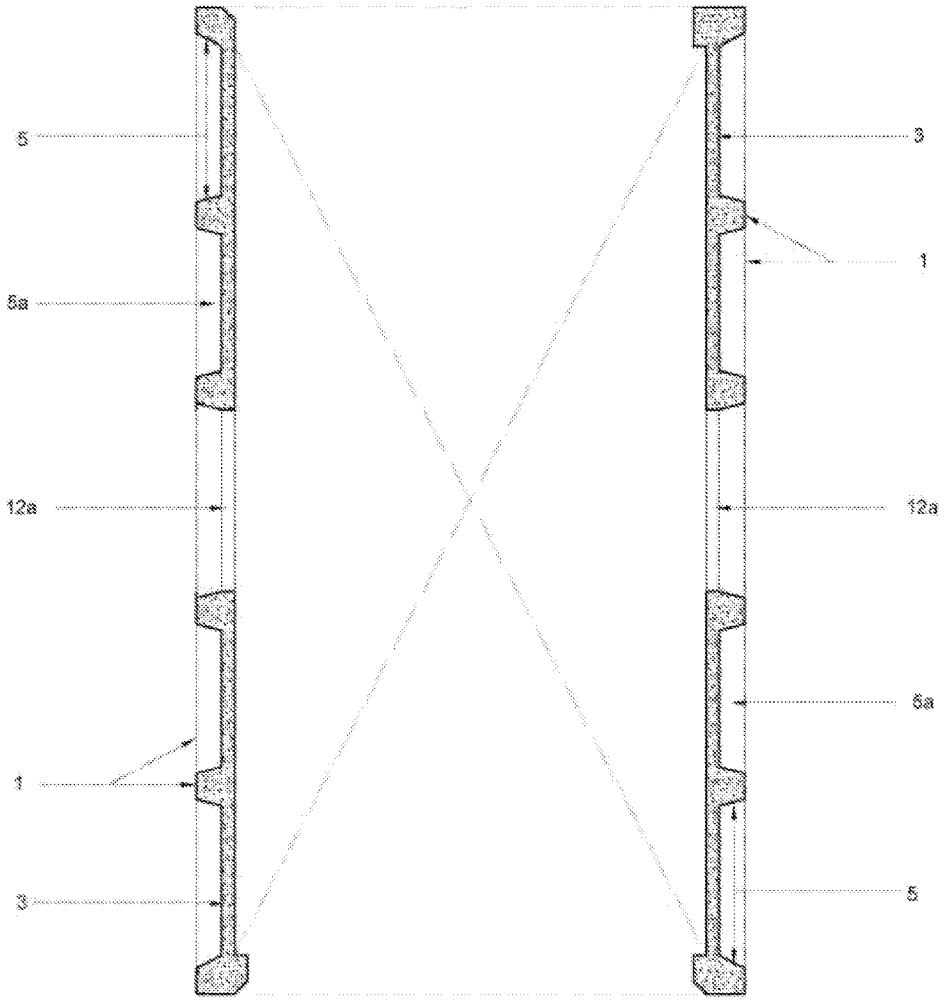


FIGURE 2a

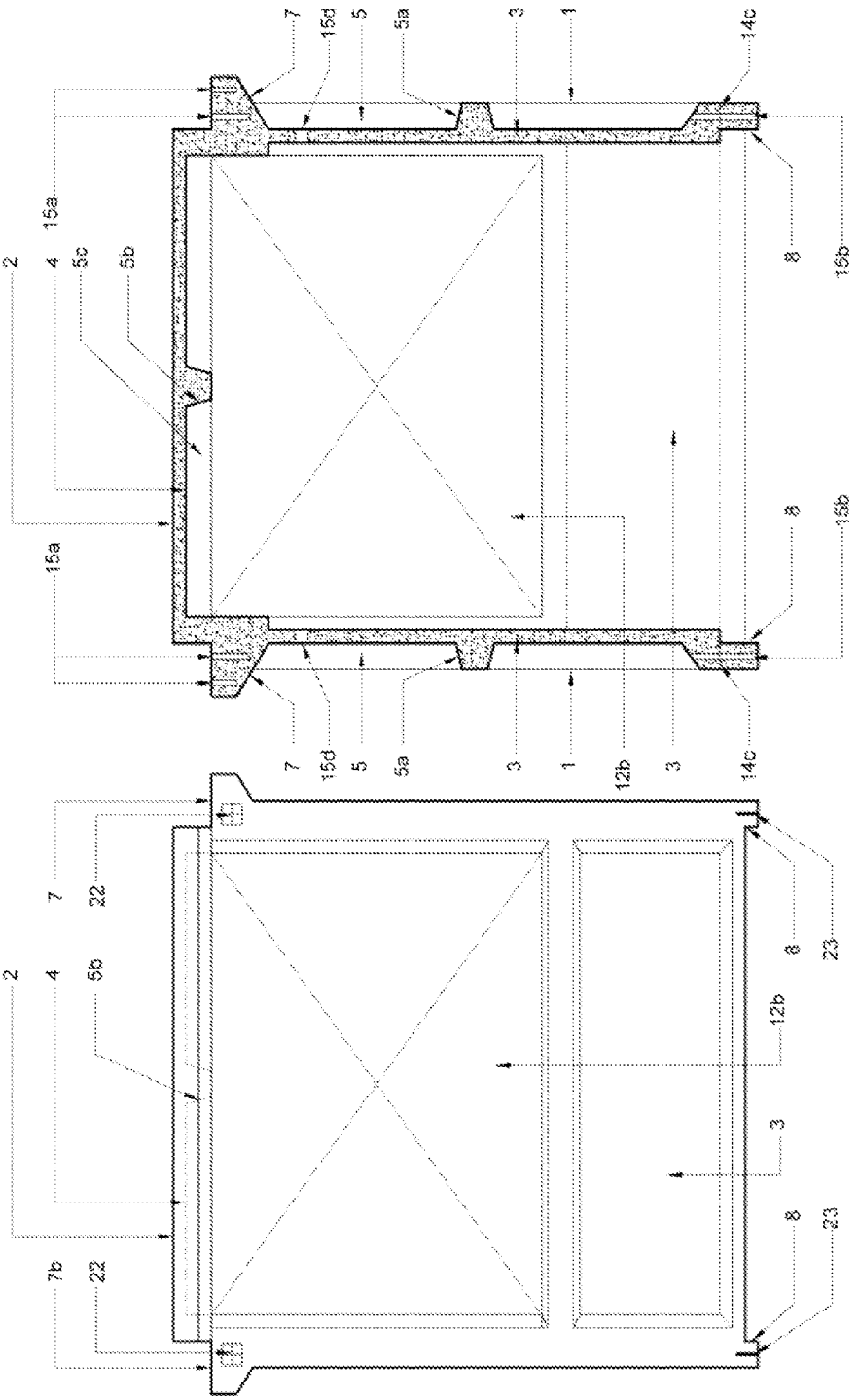


FIGURE 4

FIGURE 3

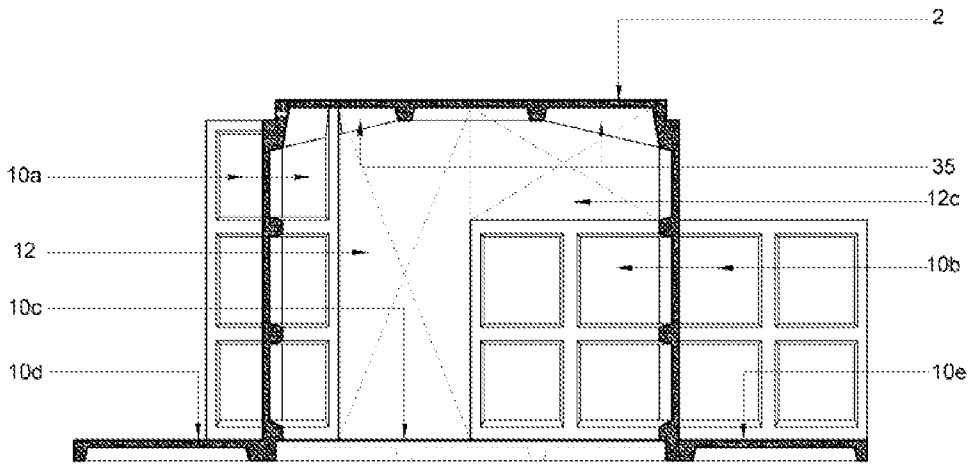


FIGURE 4a

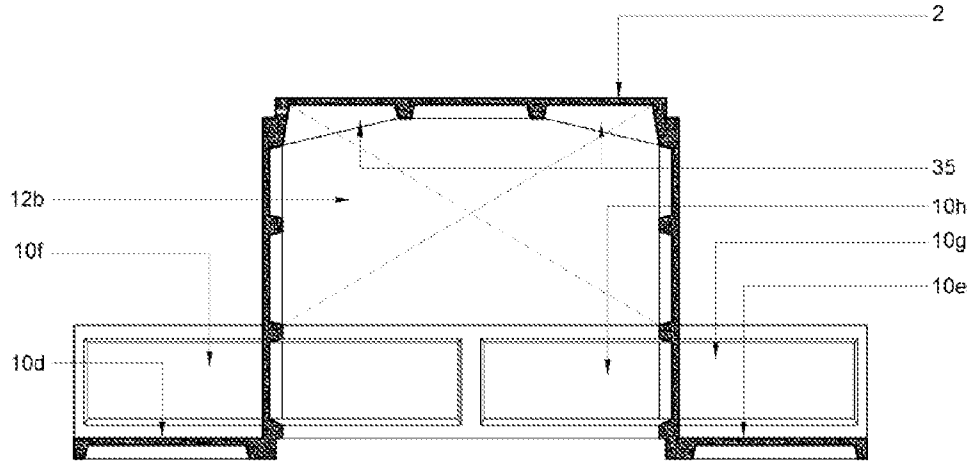


FIGURE 3a

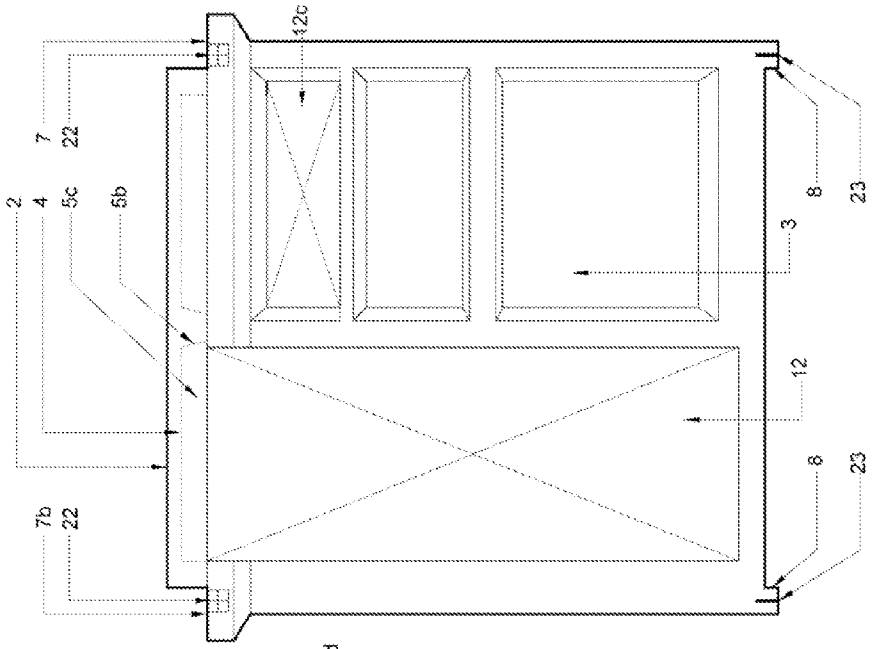
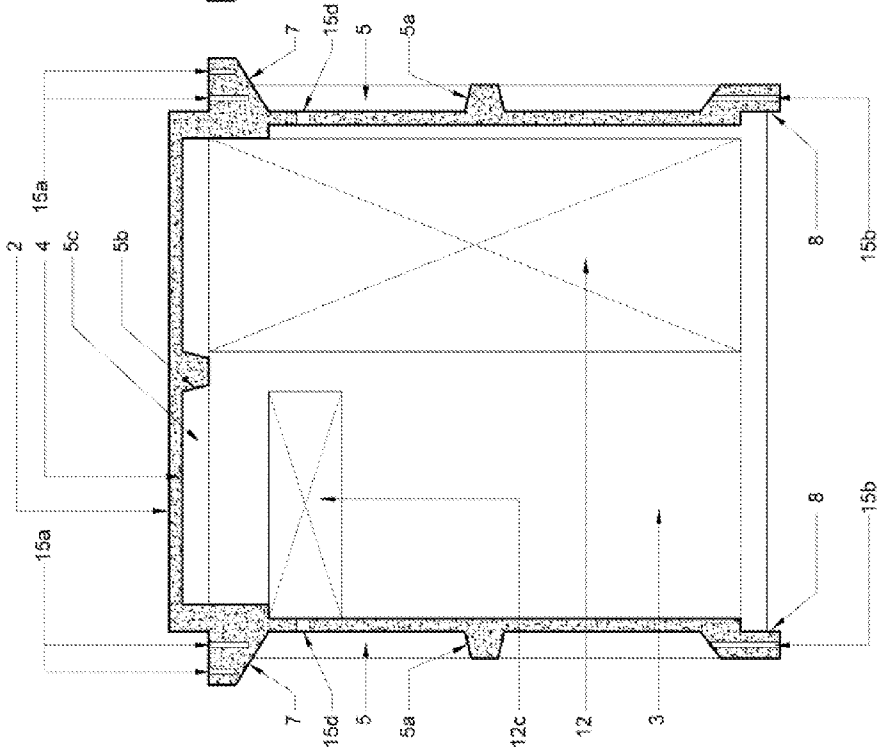


FIGURE 6



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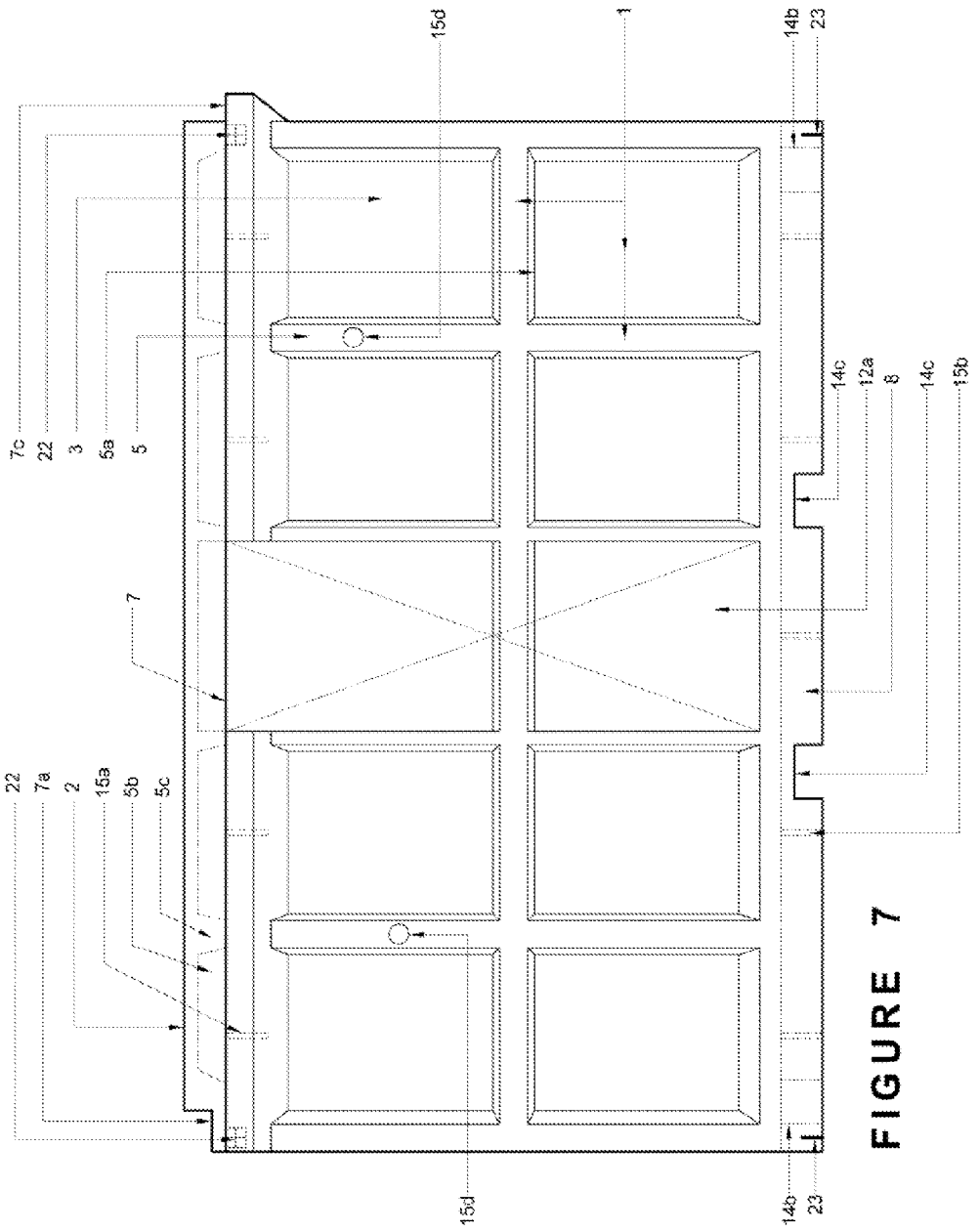
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FIGURE 7

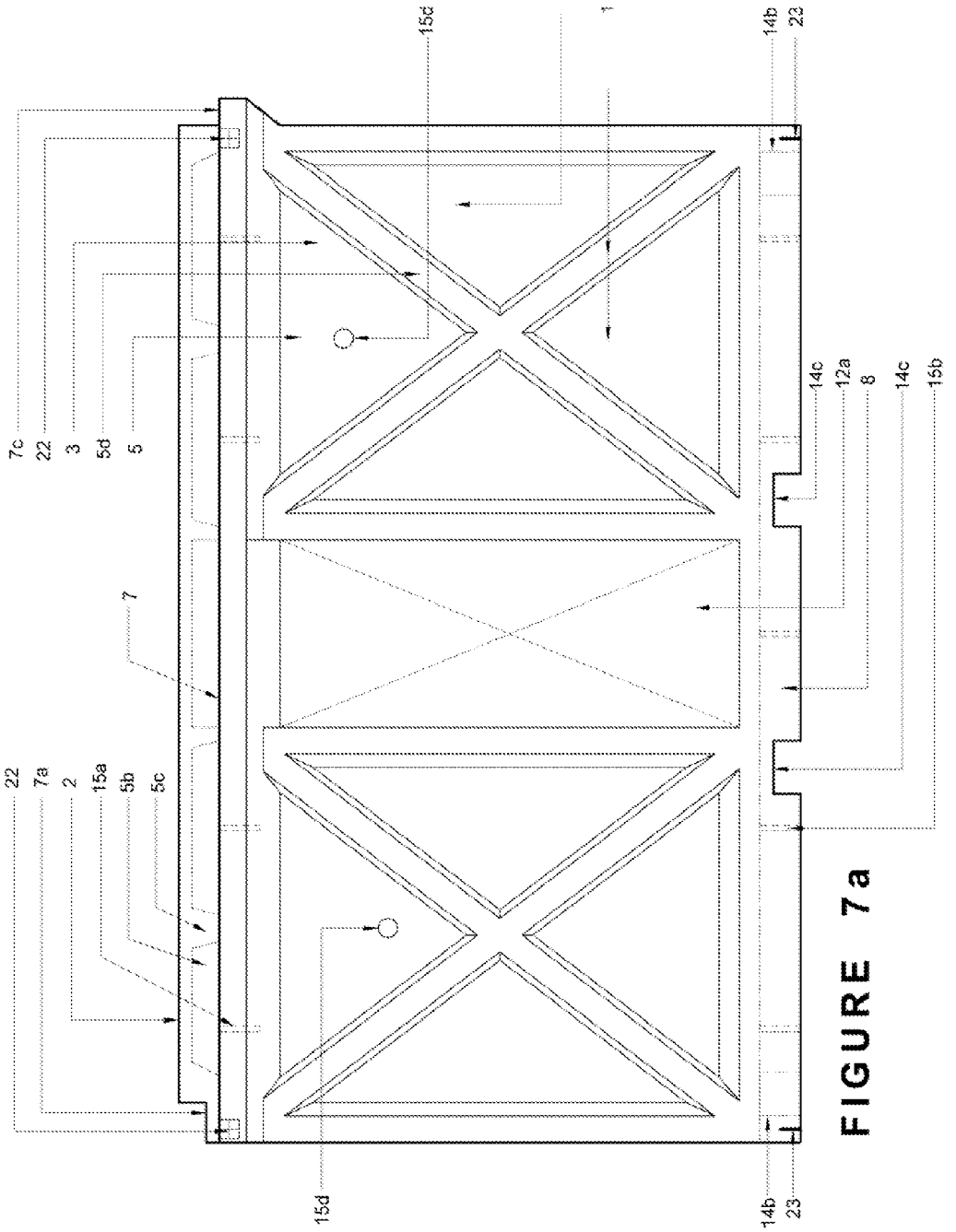
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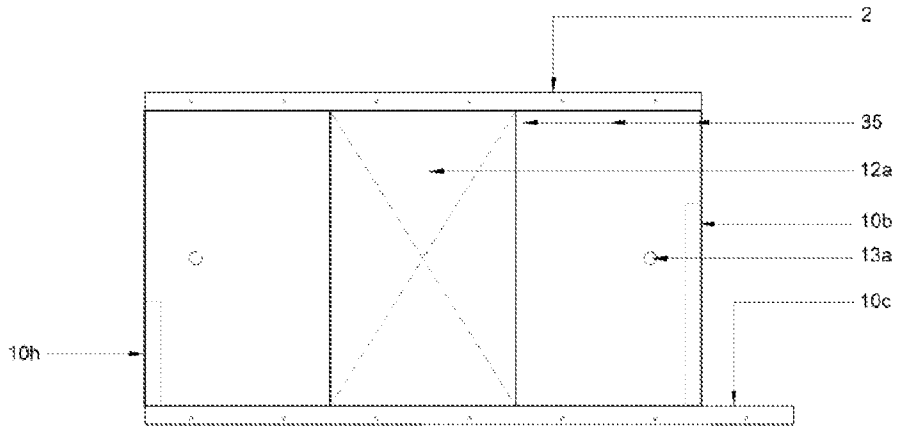
FIGURE 7a



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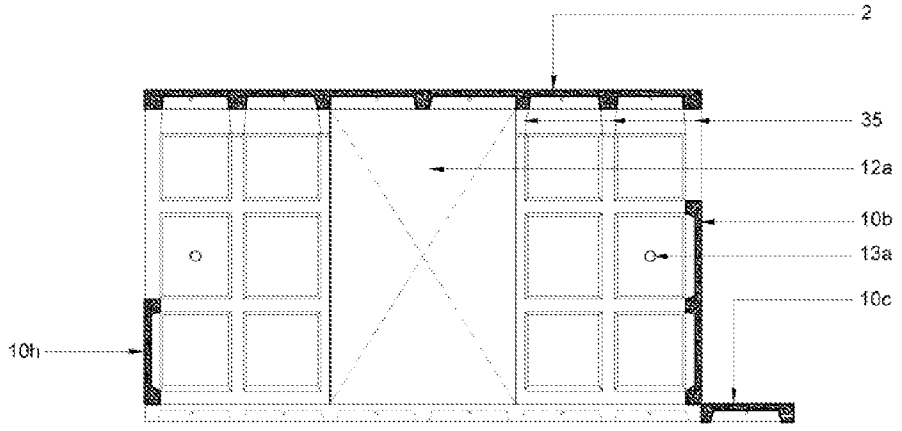

FIGURE 7b

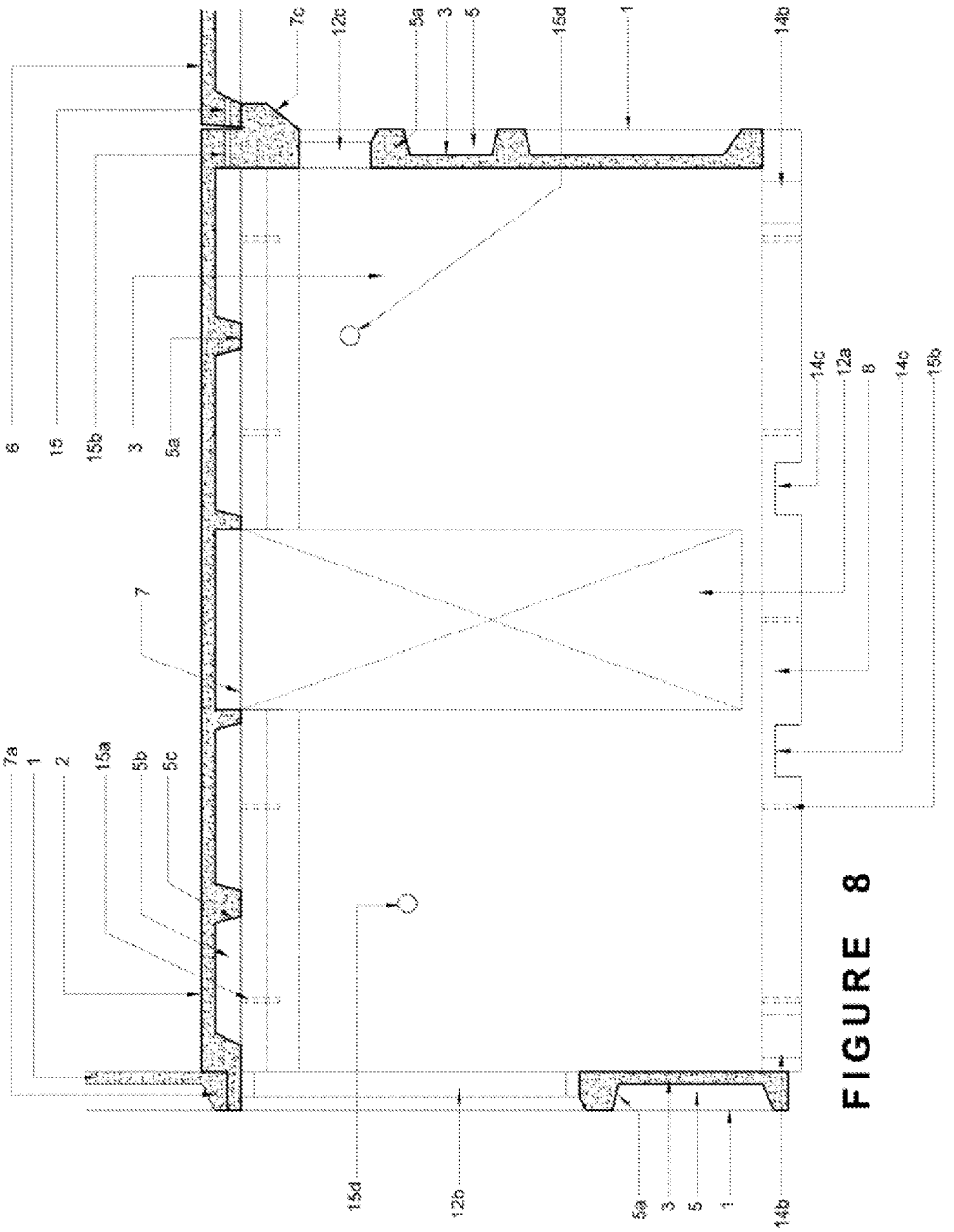
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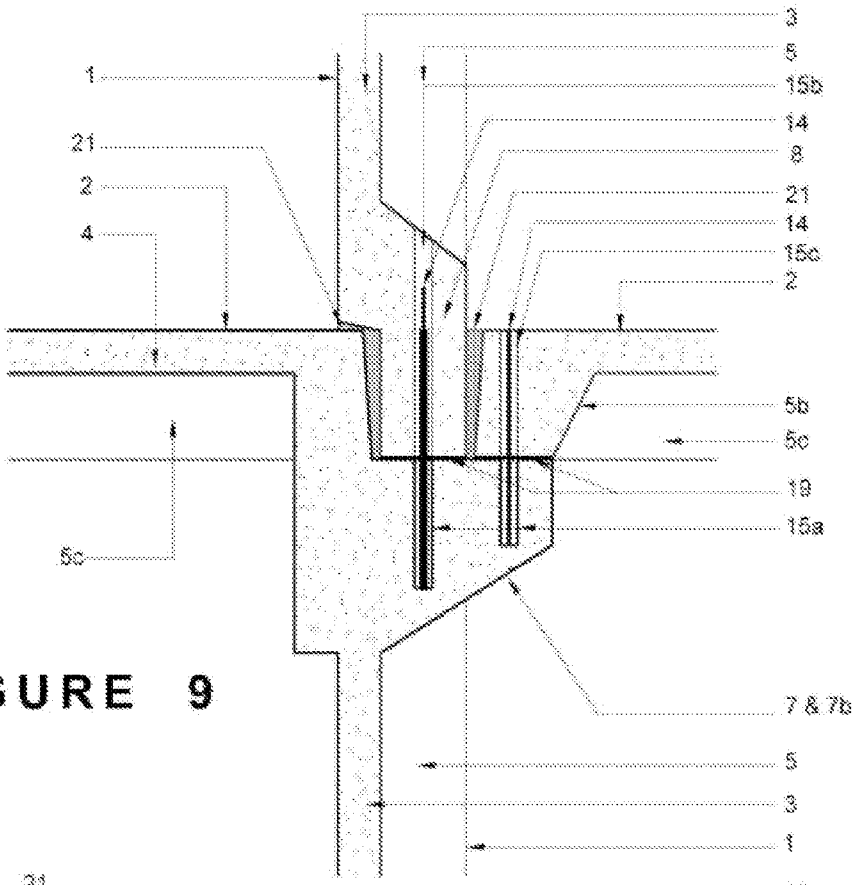
FIGURE 8



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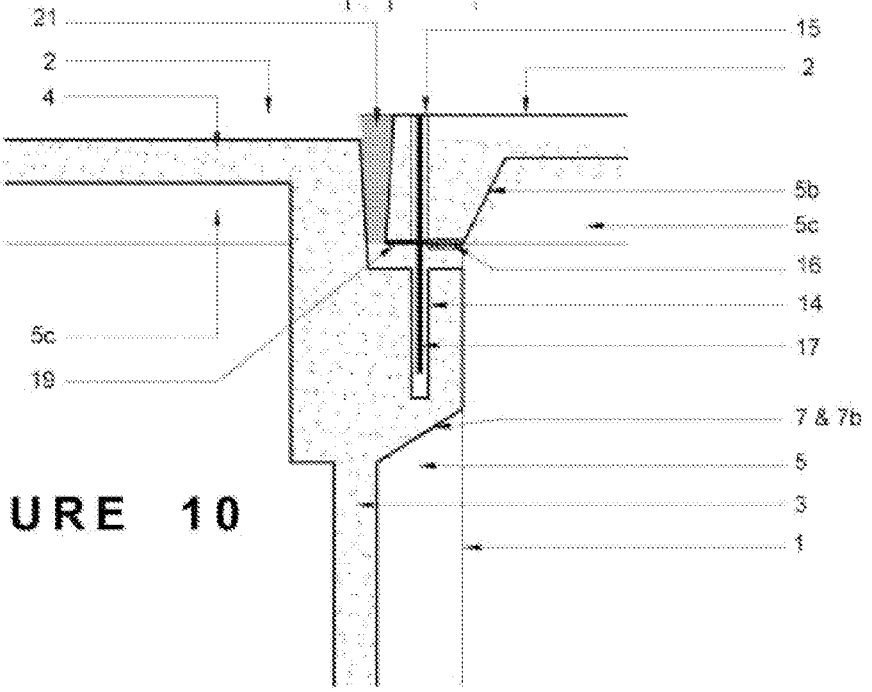

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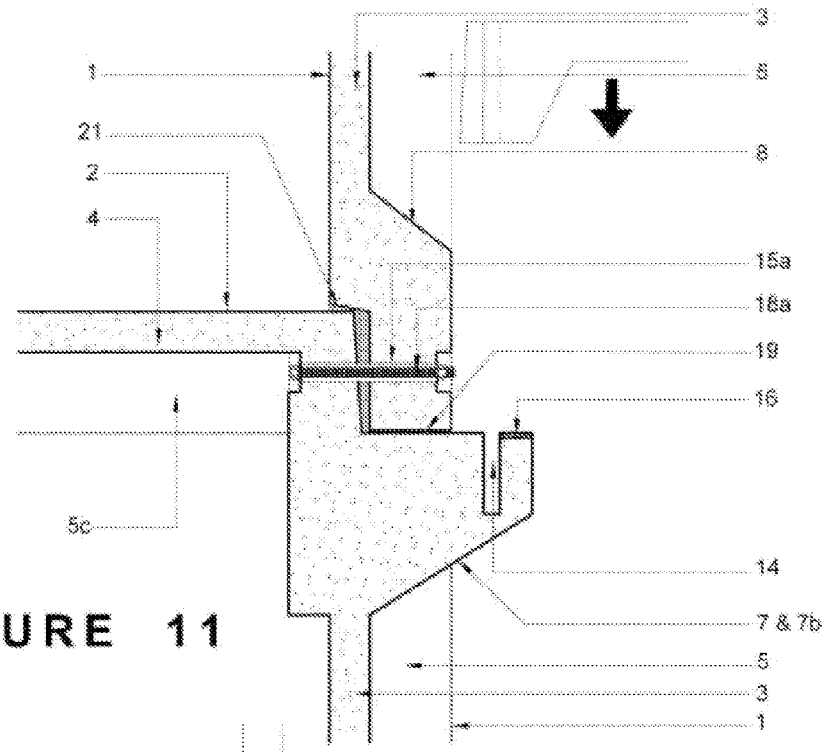

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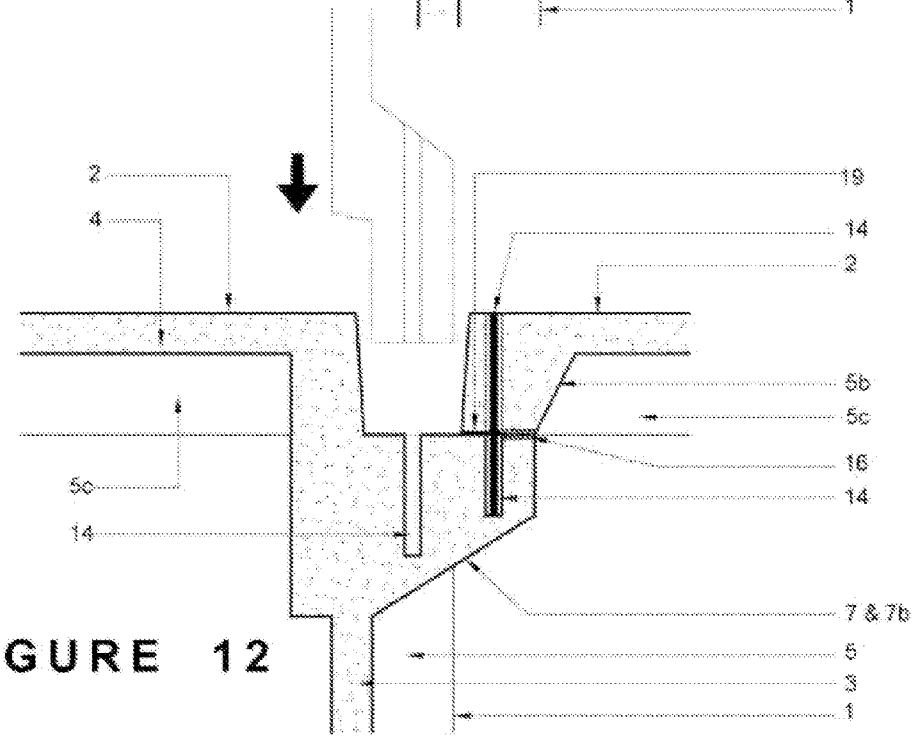

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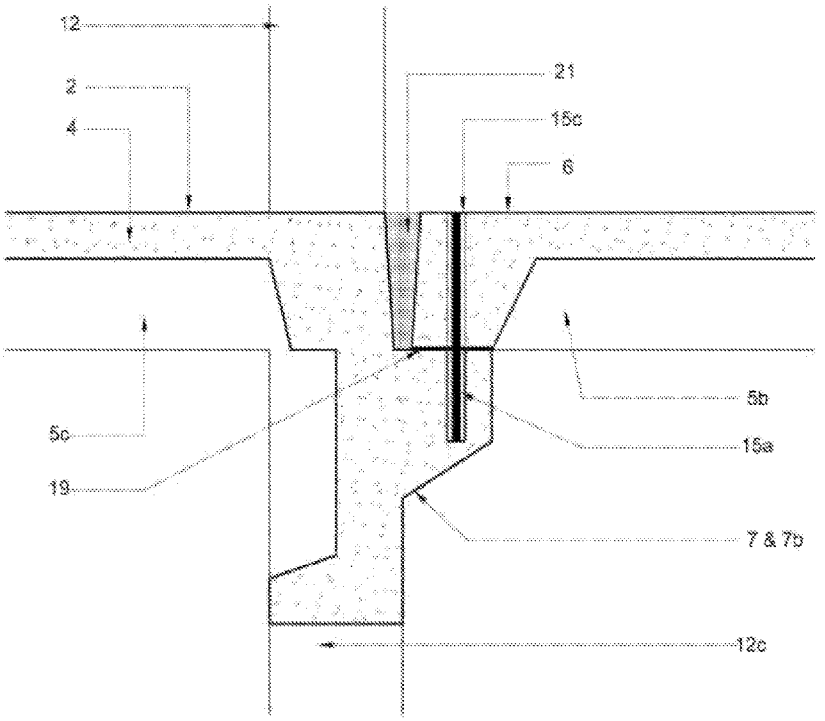

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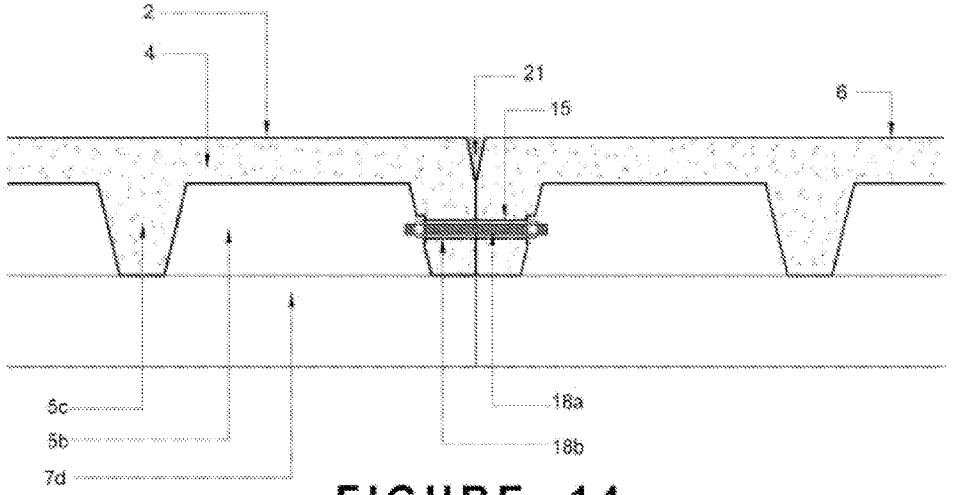

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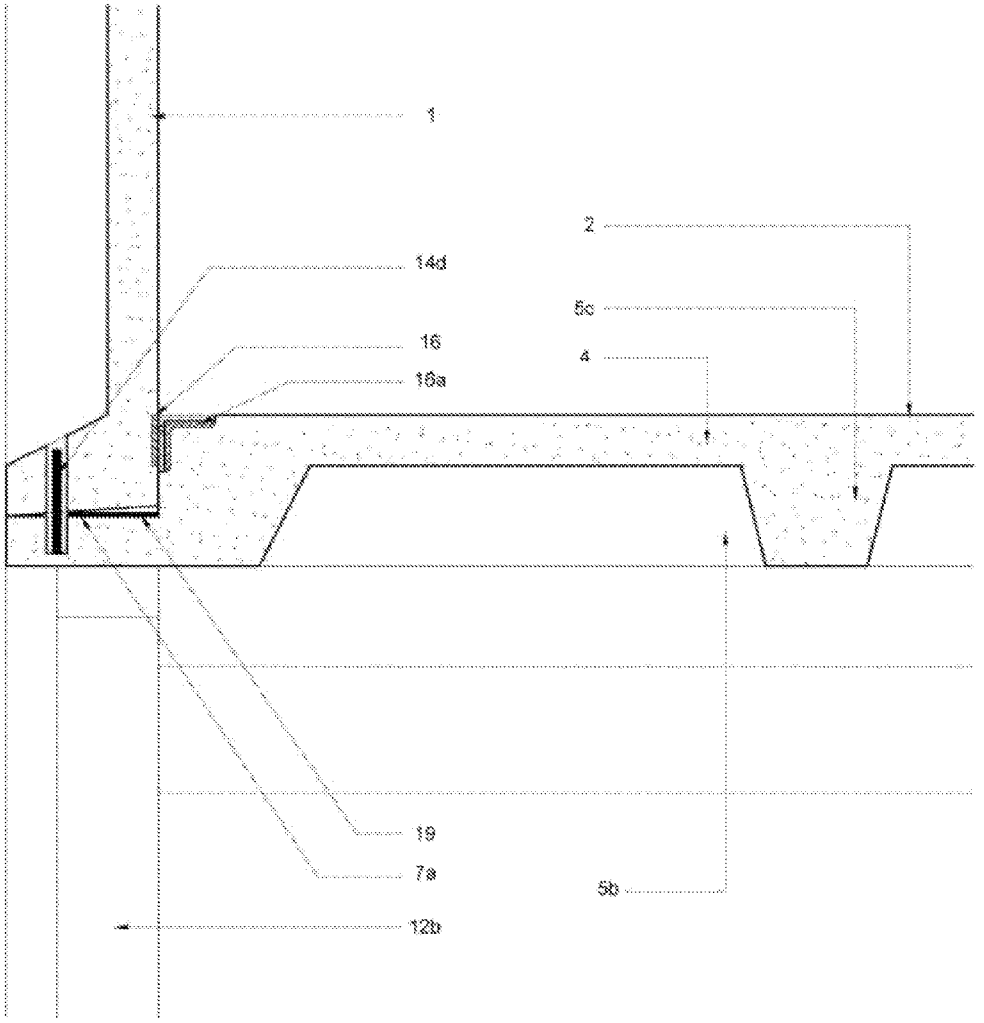

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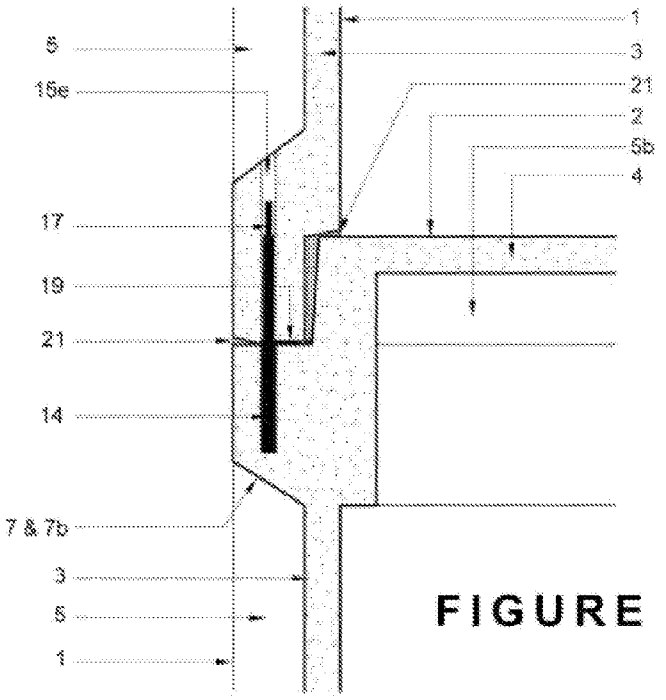

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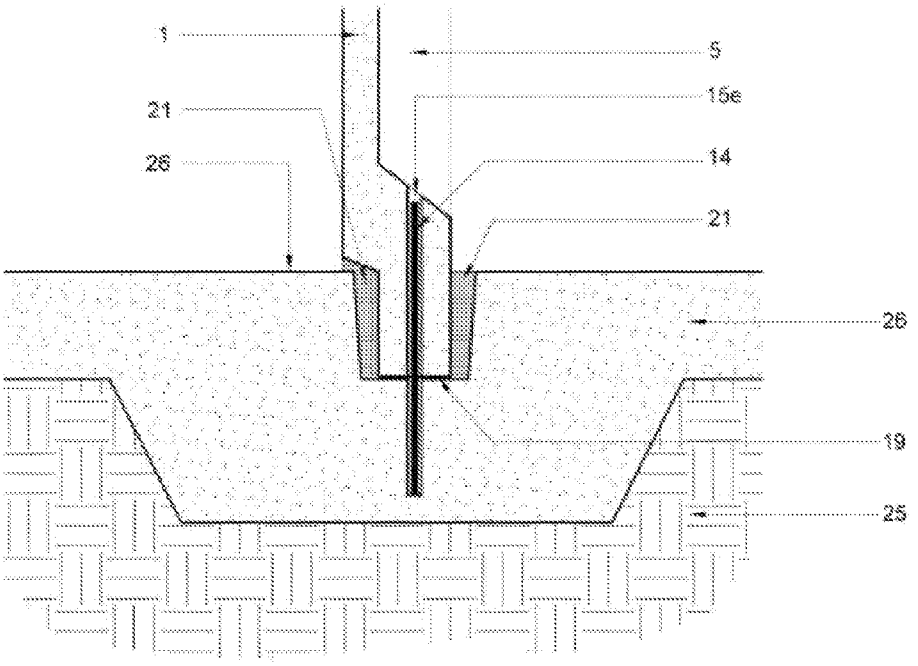

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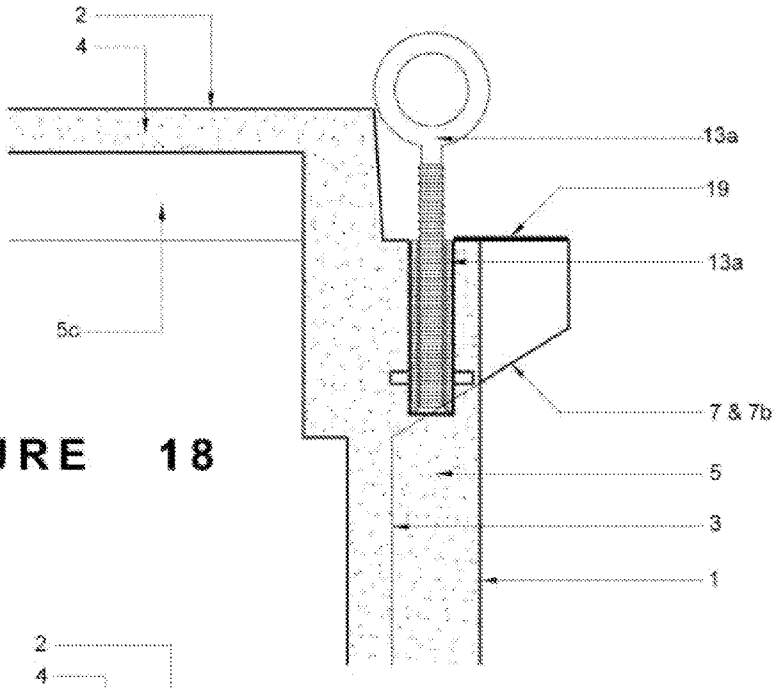

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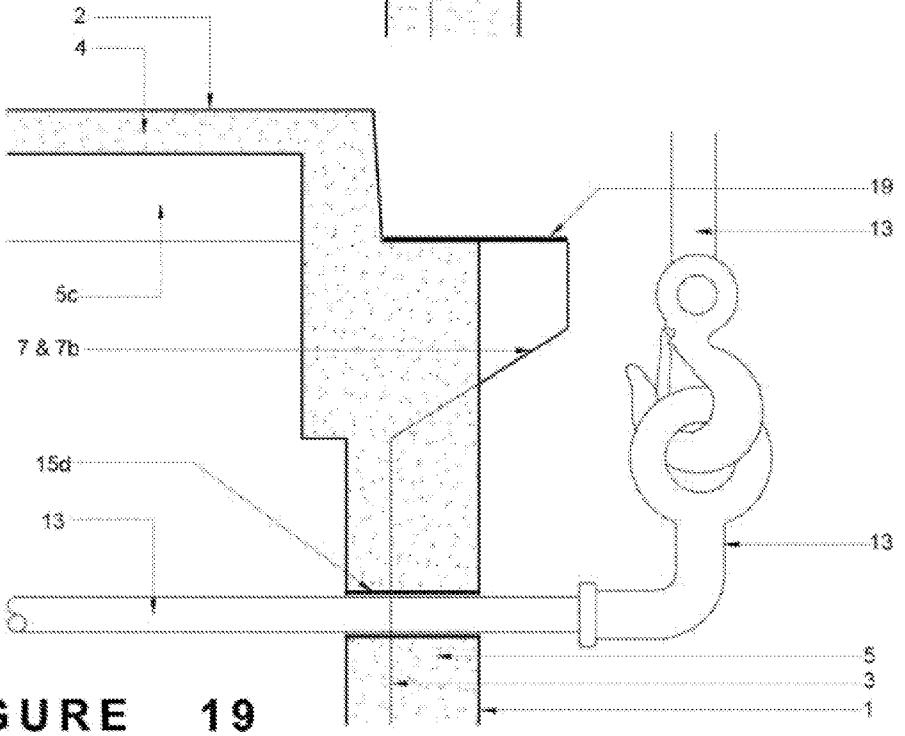

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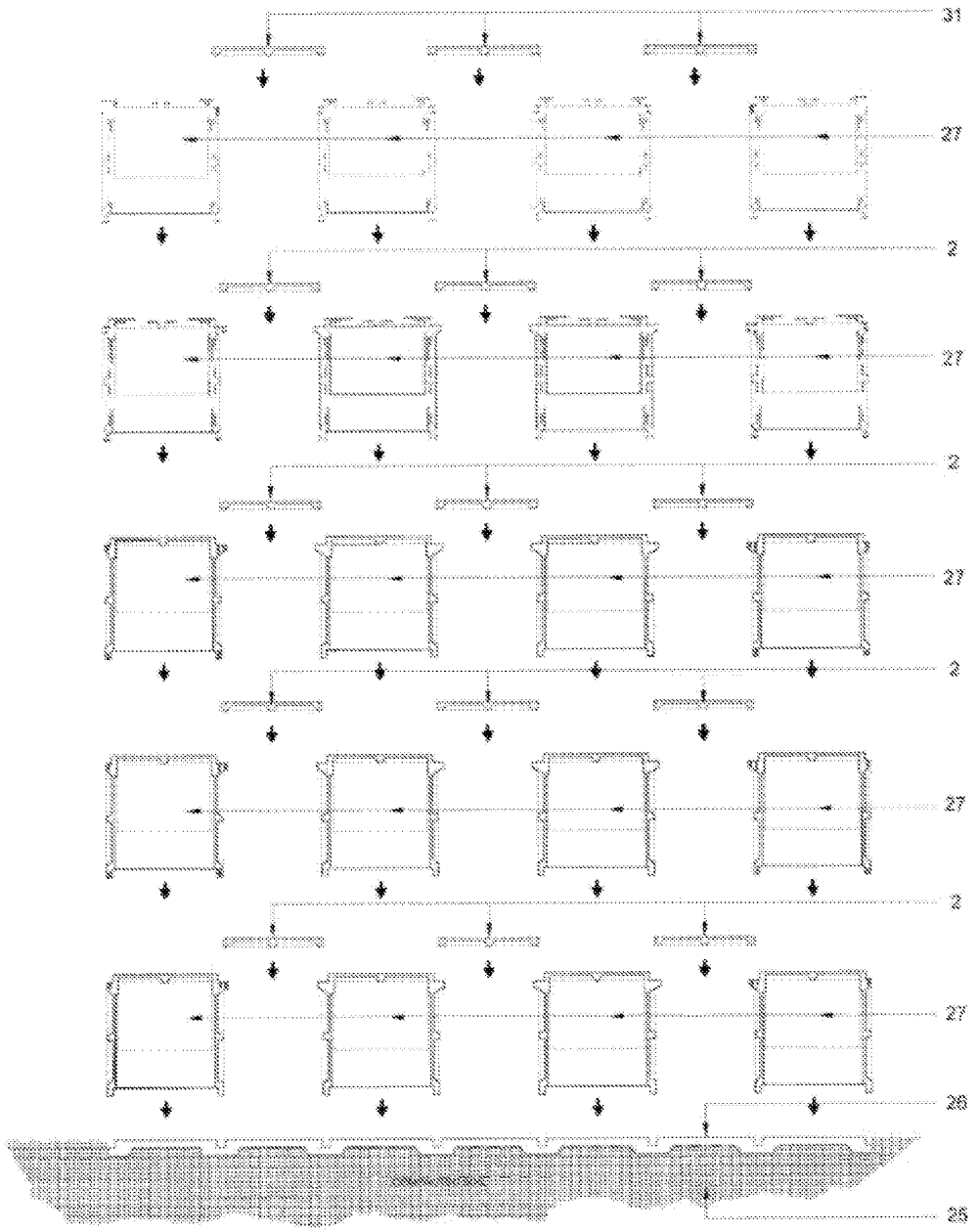

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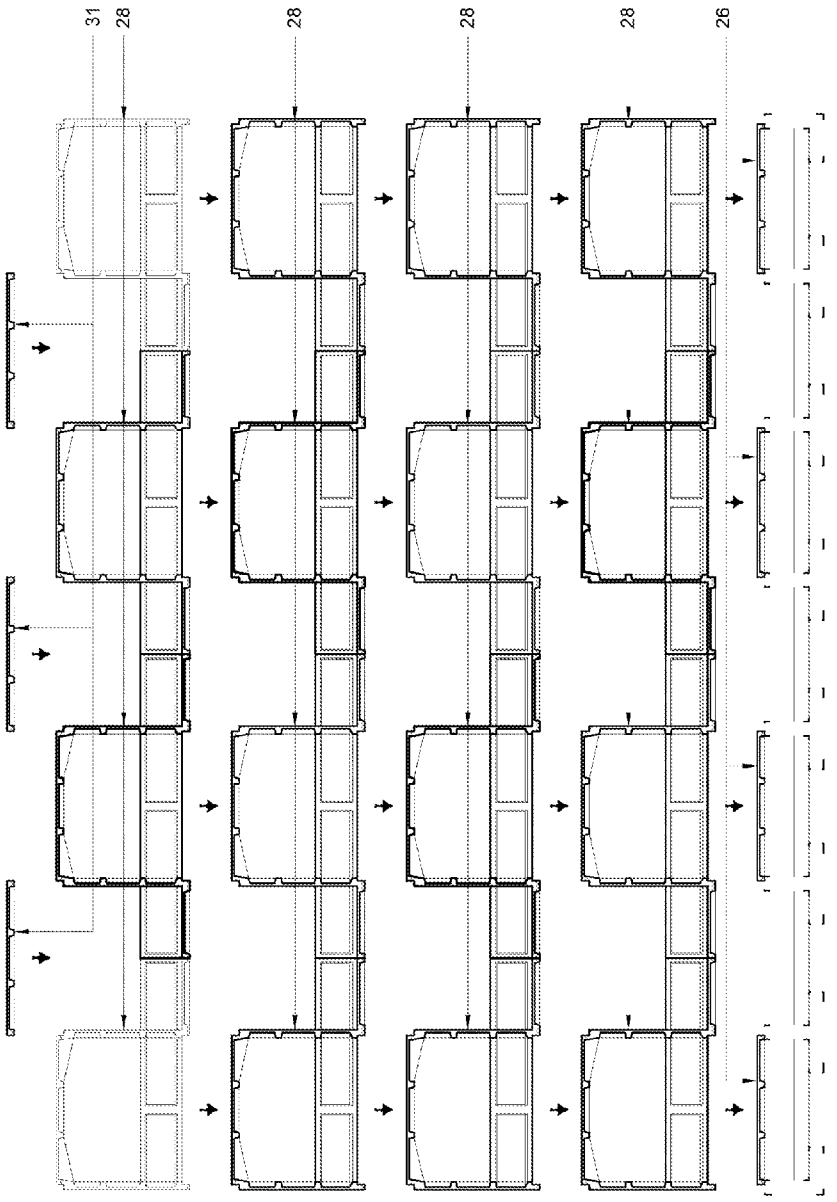
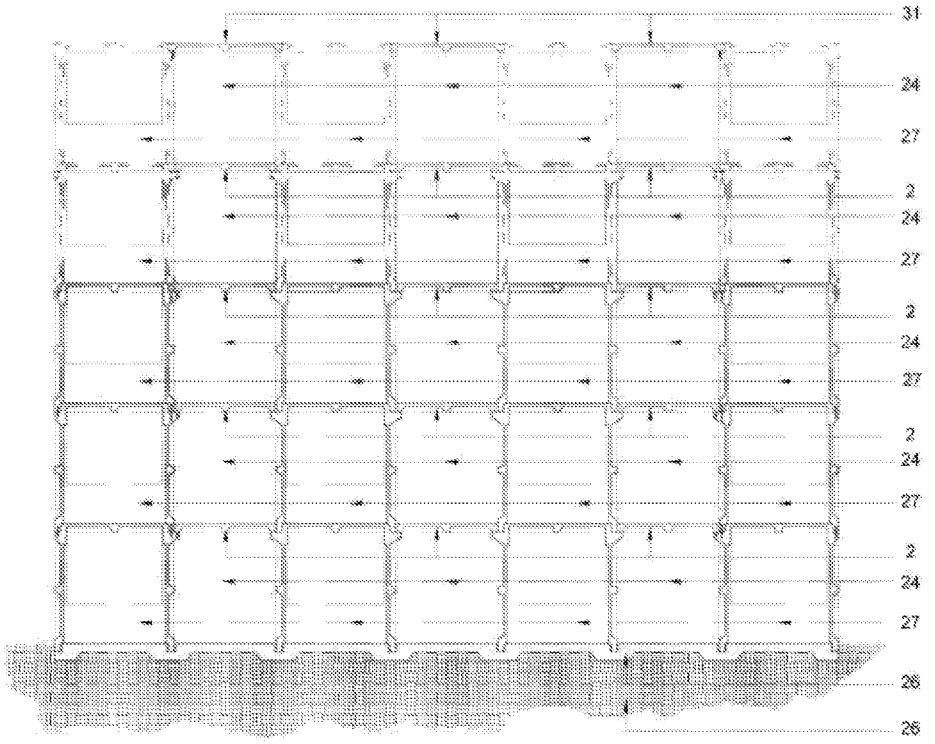


FIGURE 20a



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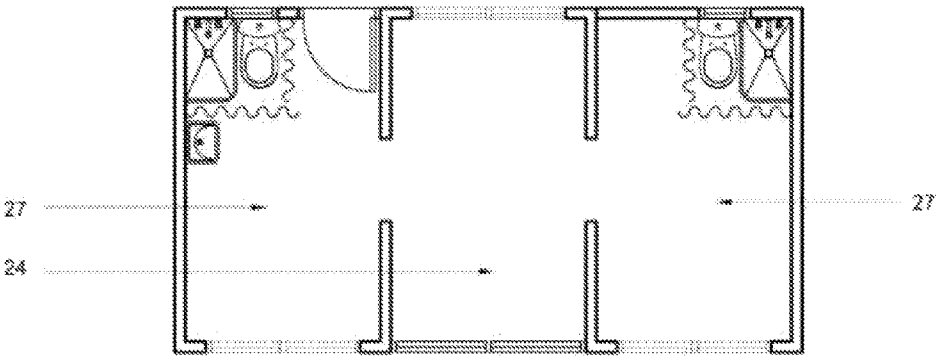

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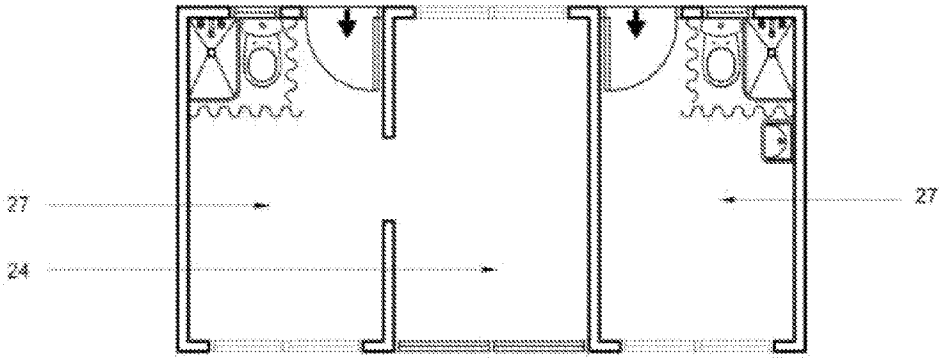

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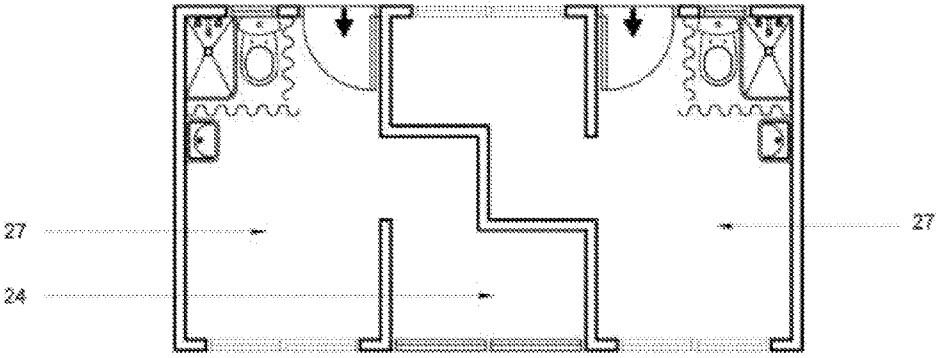

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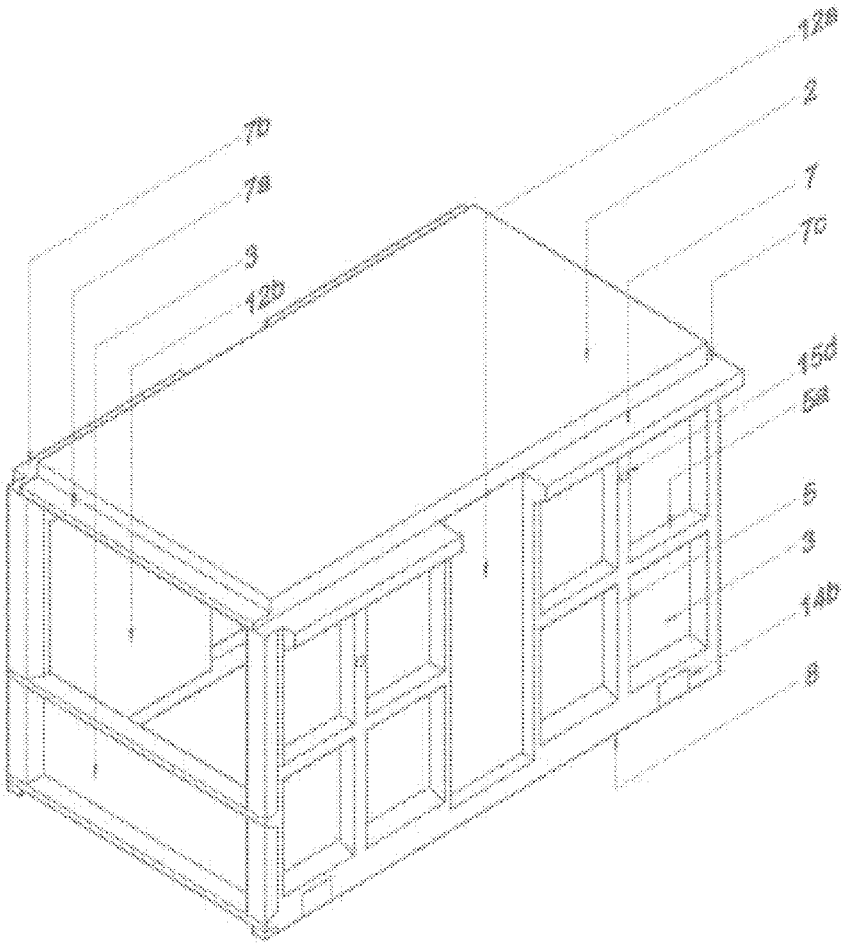

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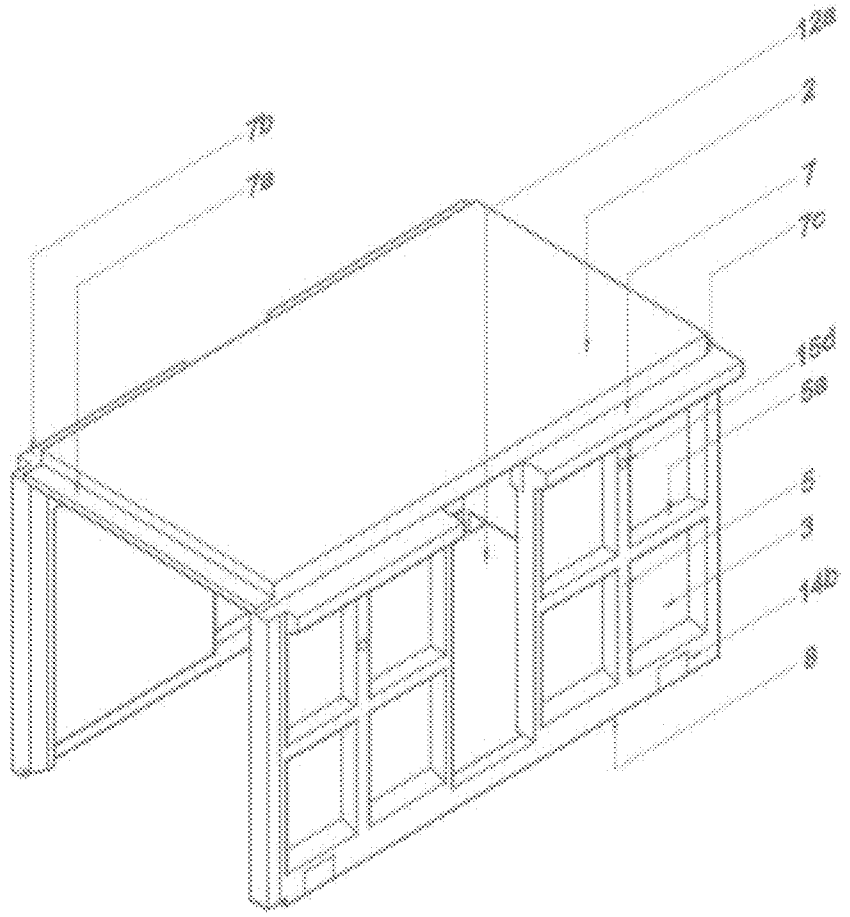


FIGURE 25a

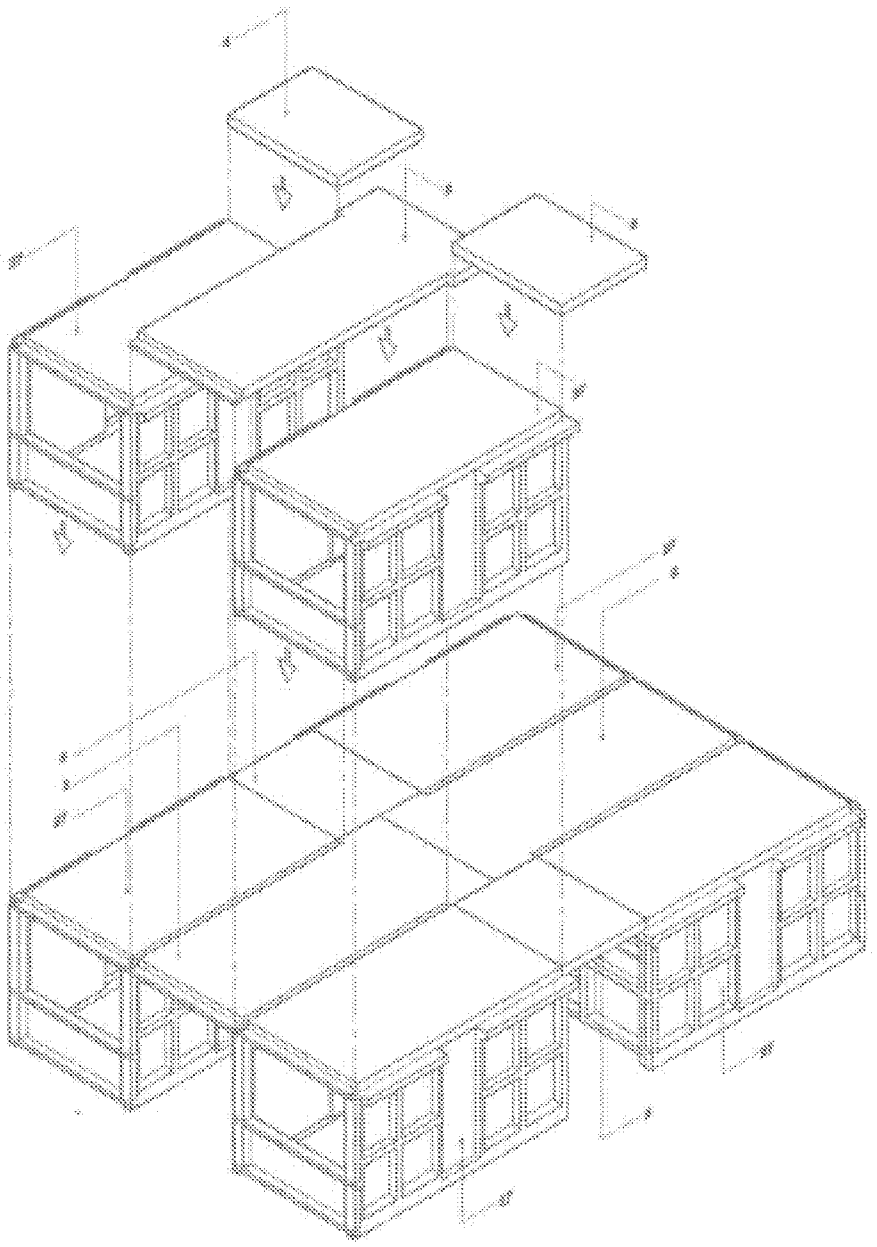
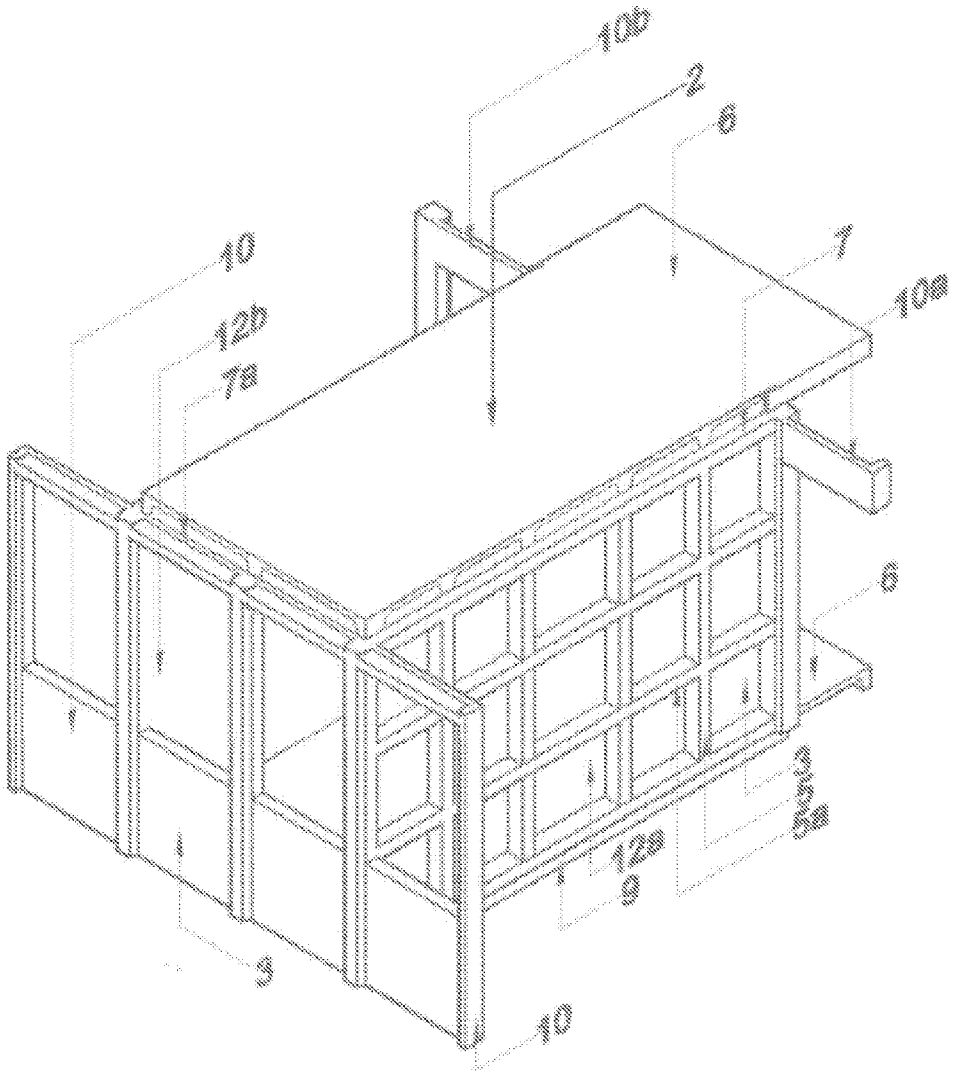


FIGURE 26



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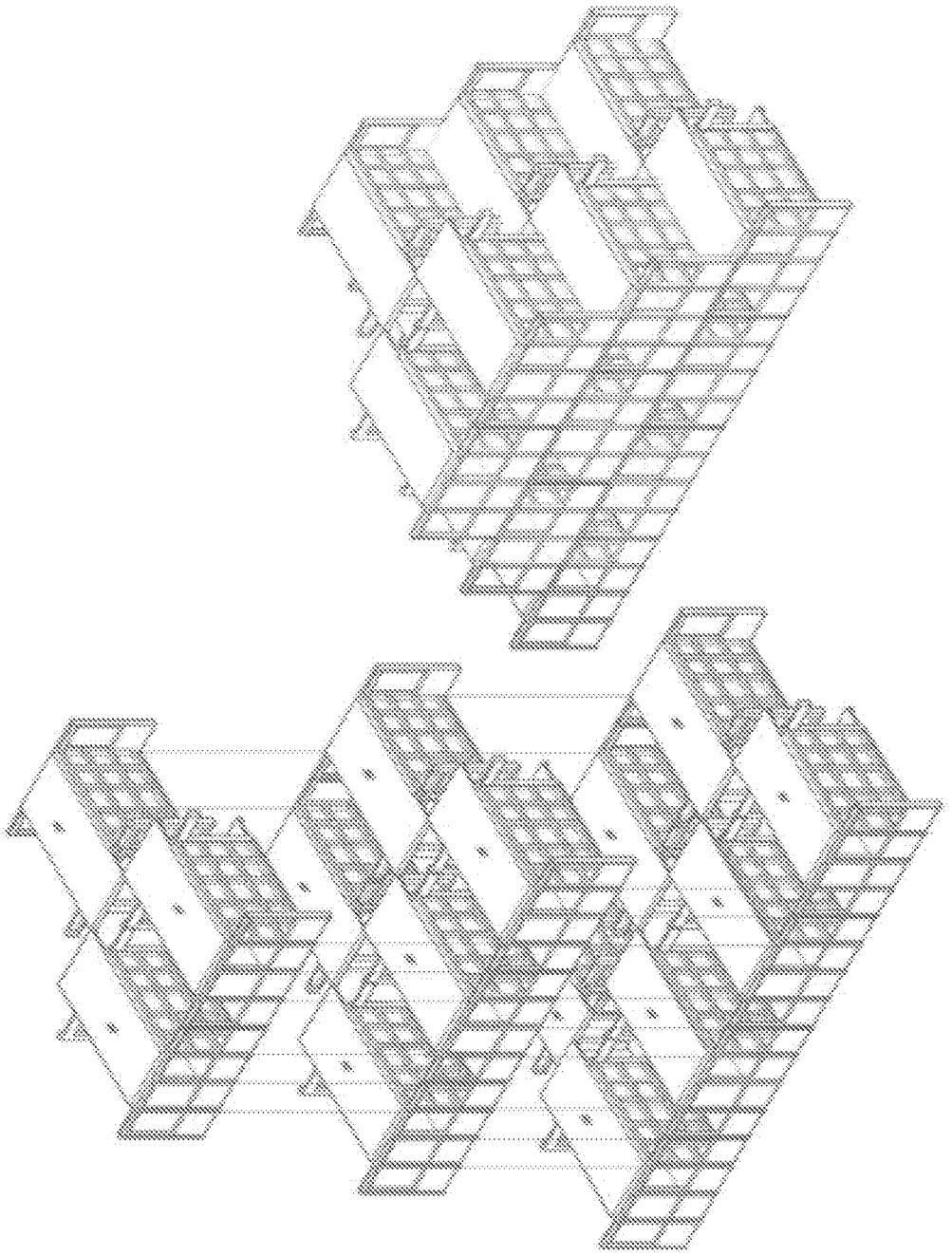


FIGURE 27a

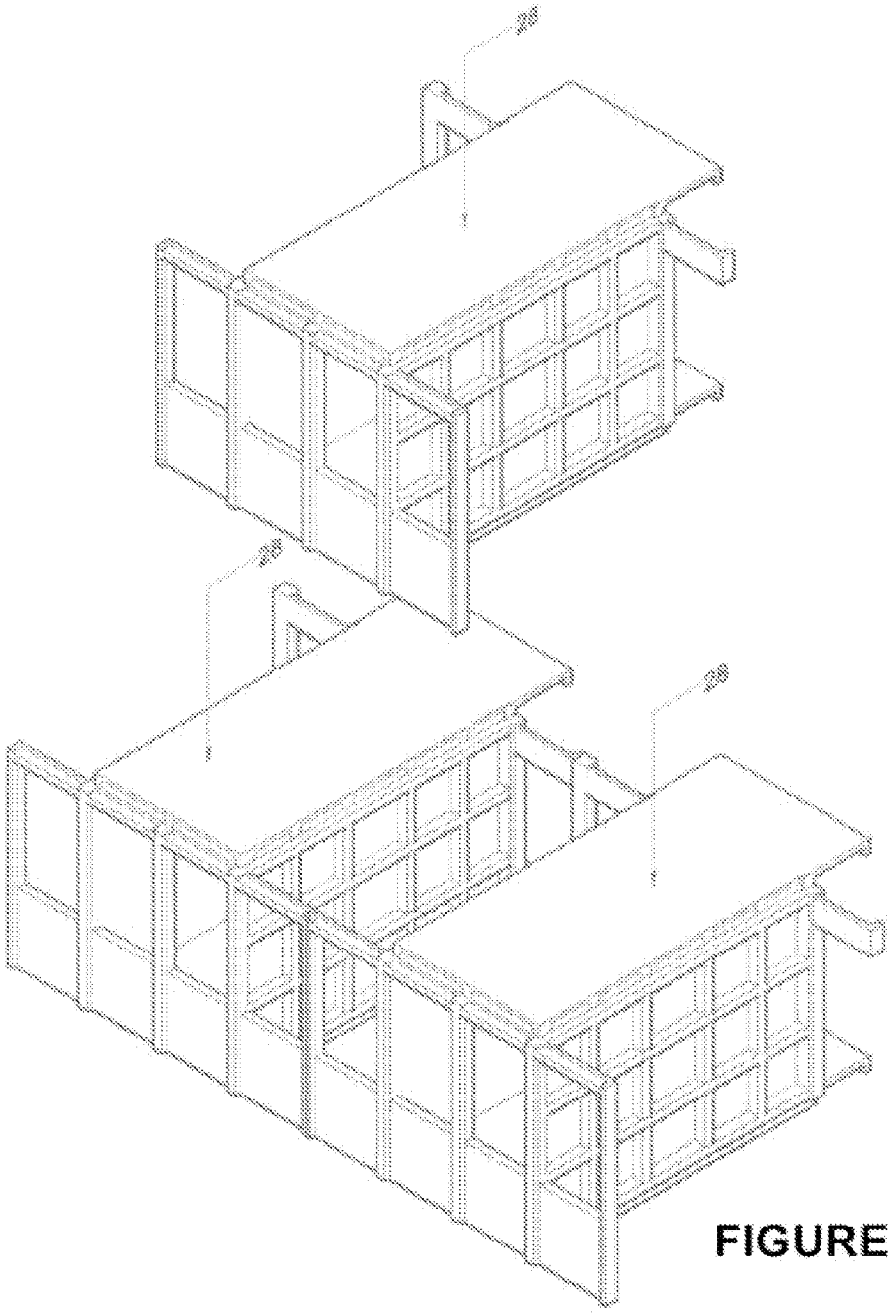
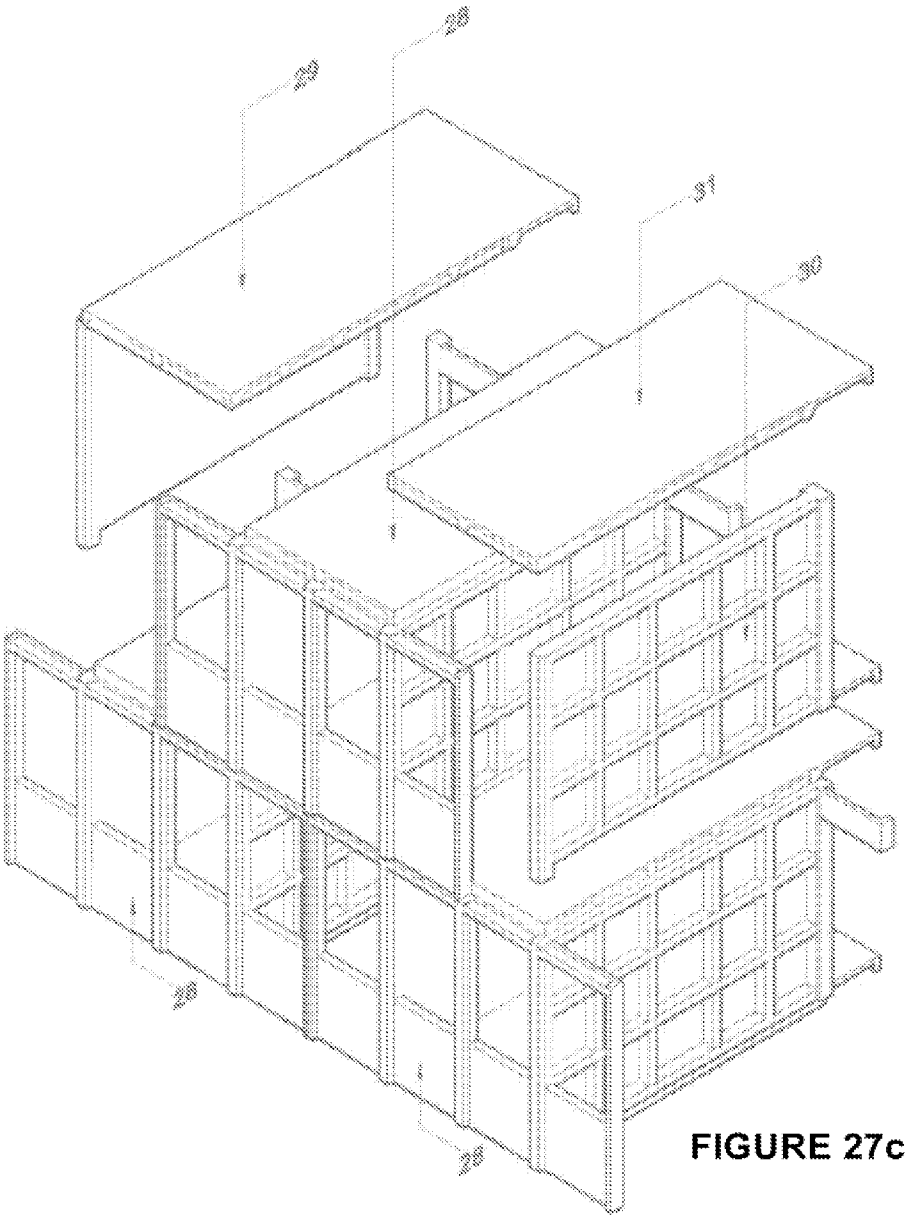


FIGURE 27b



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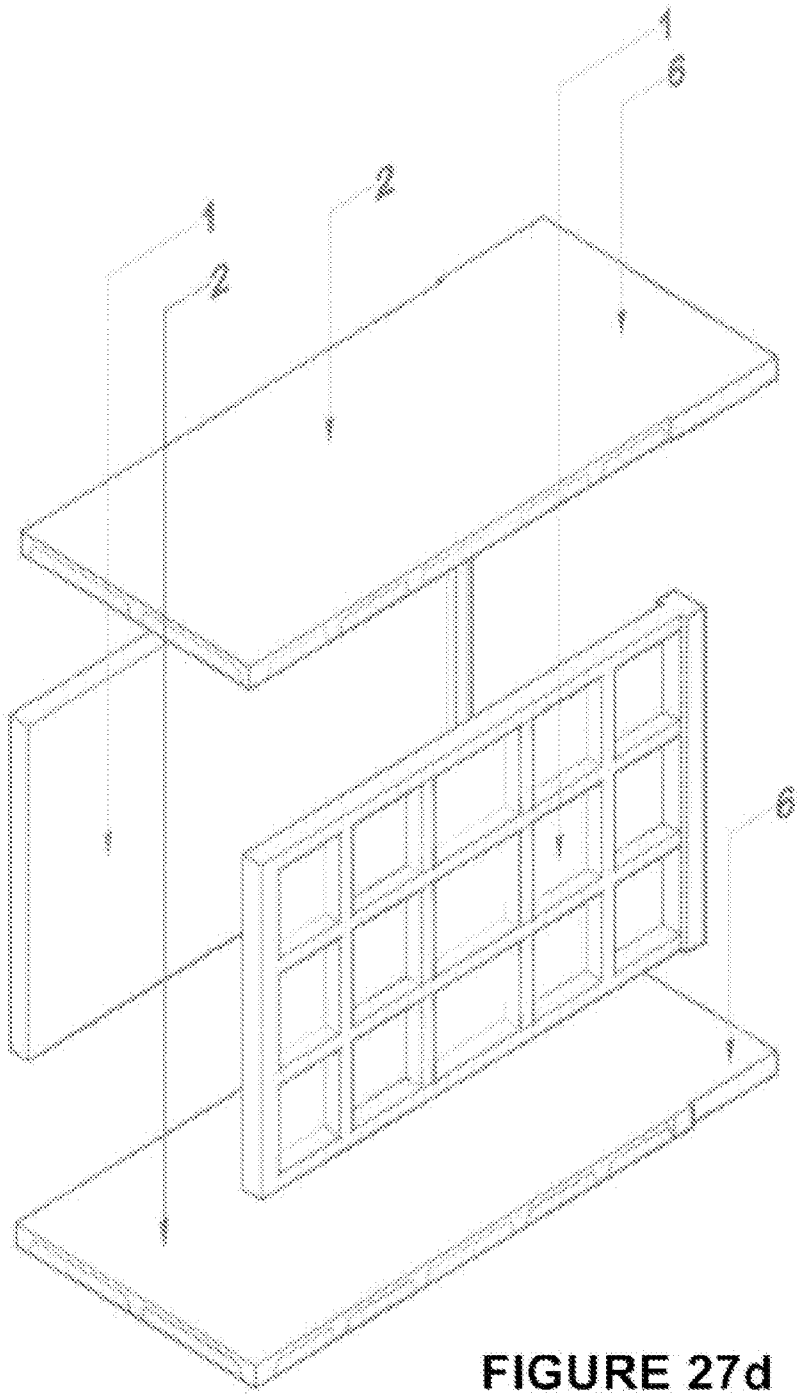

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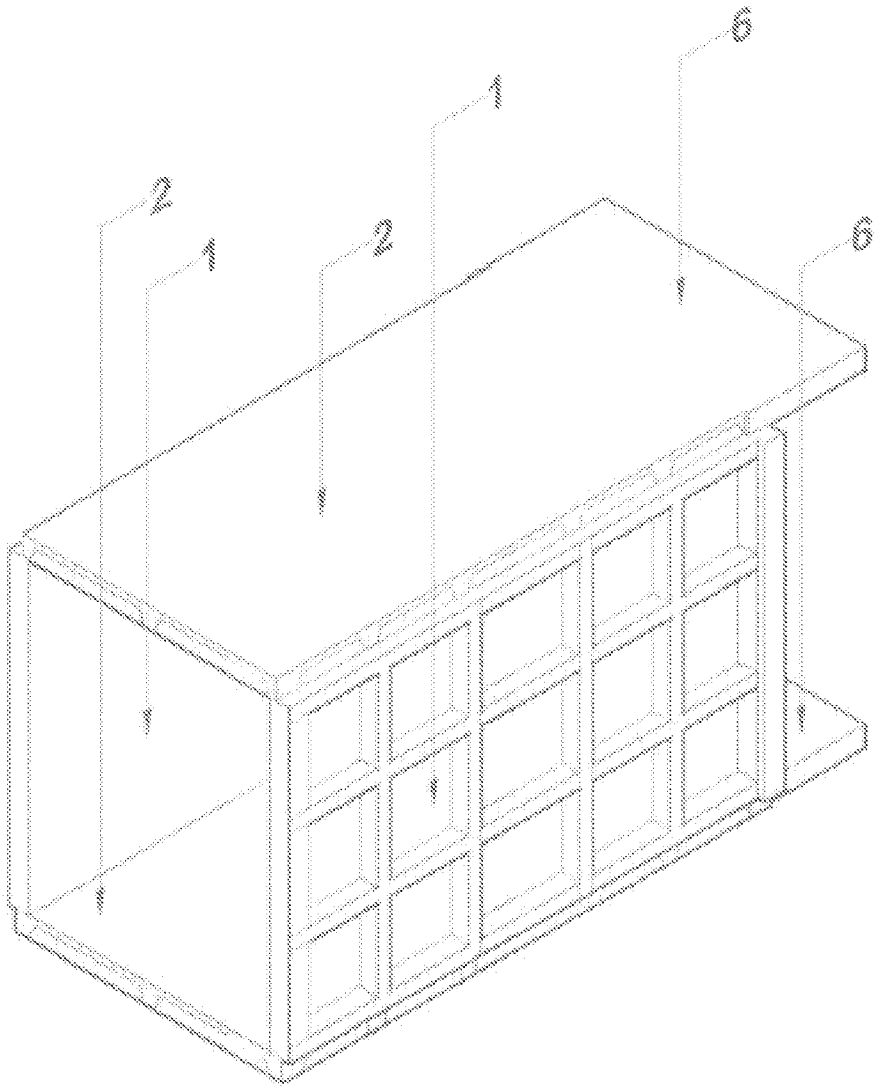

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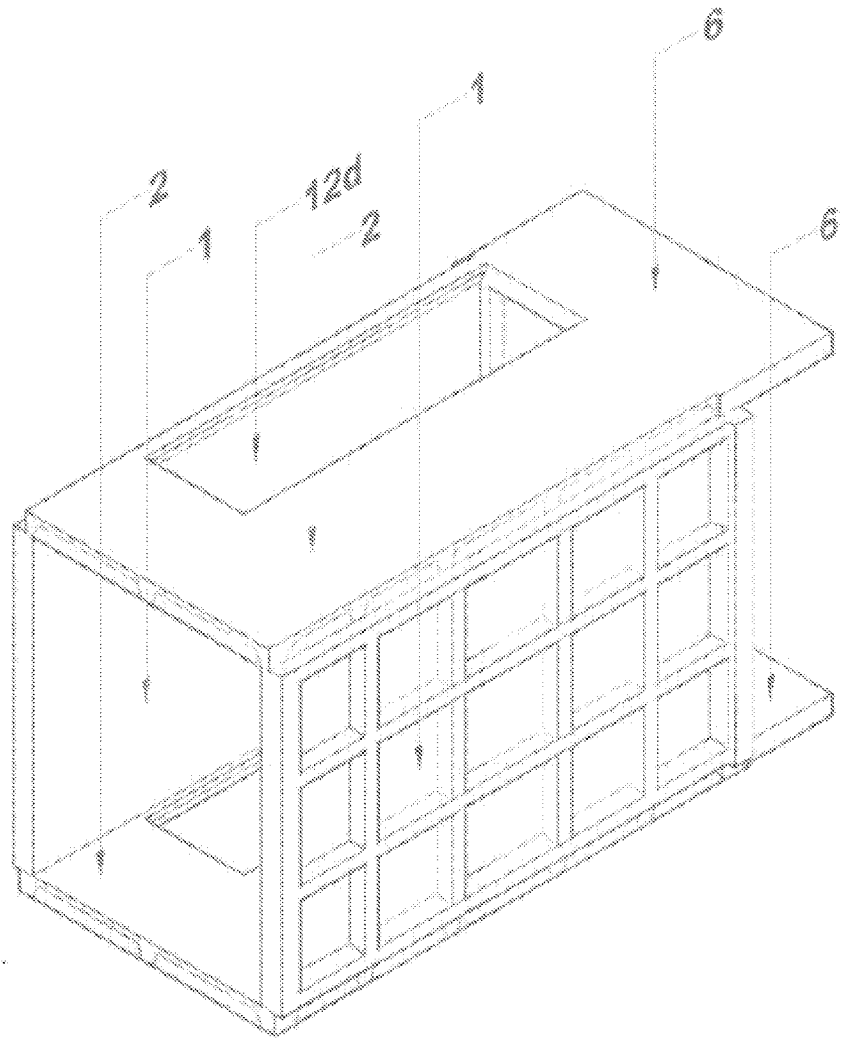

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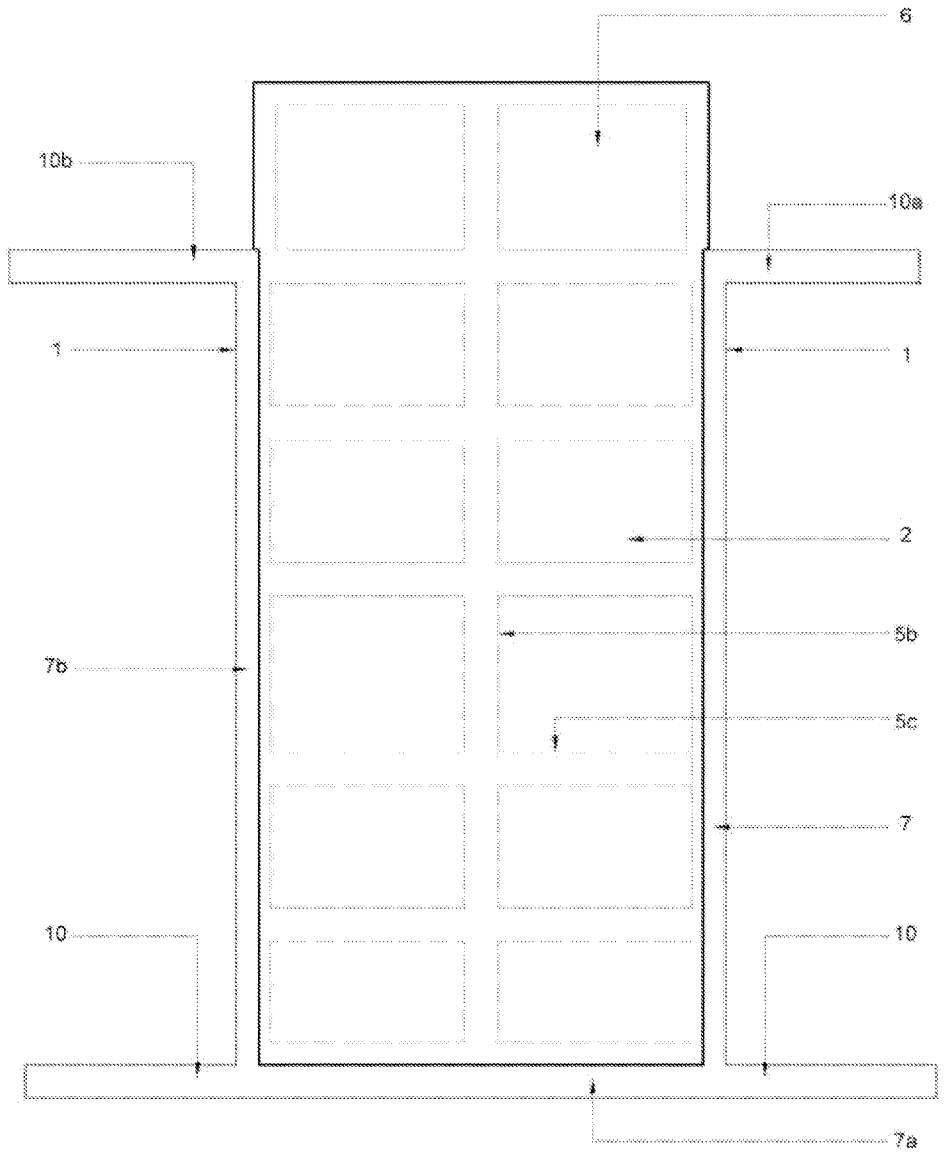

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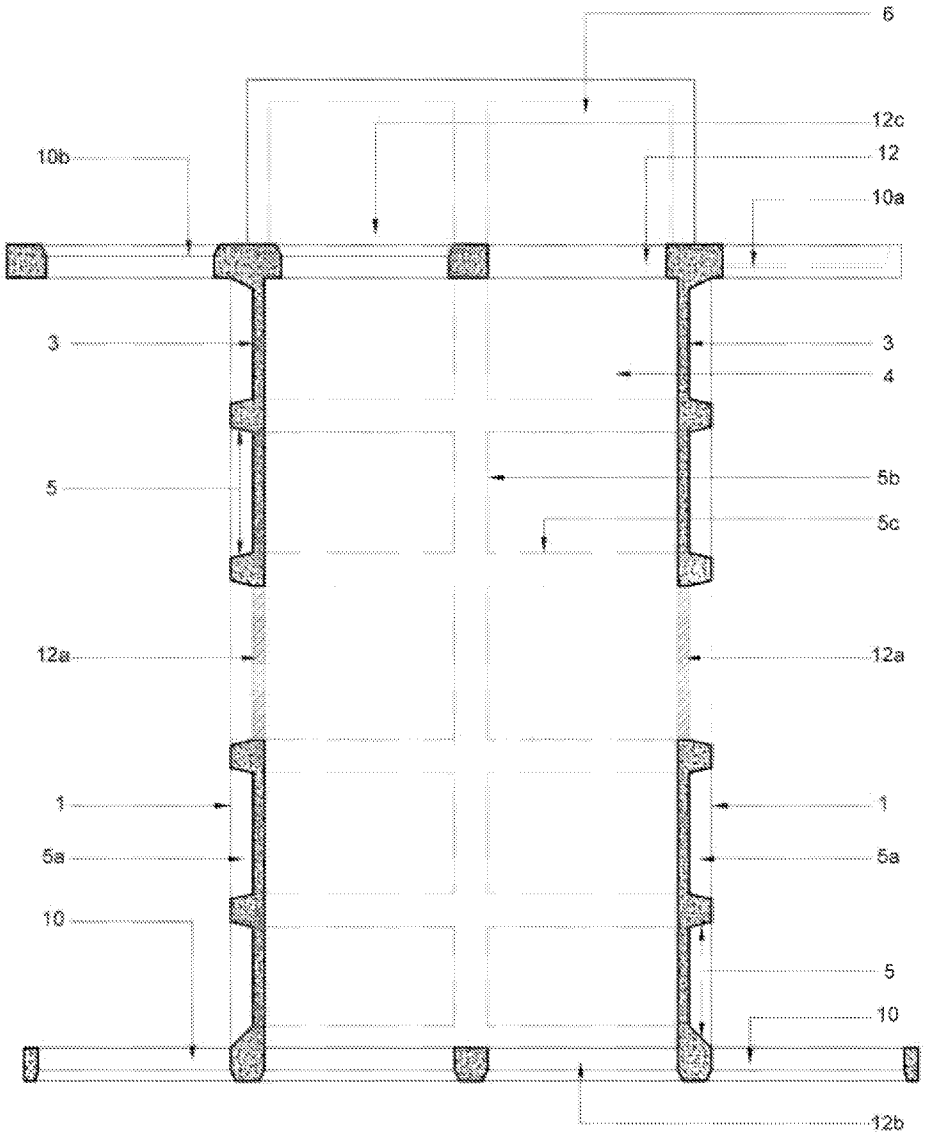

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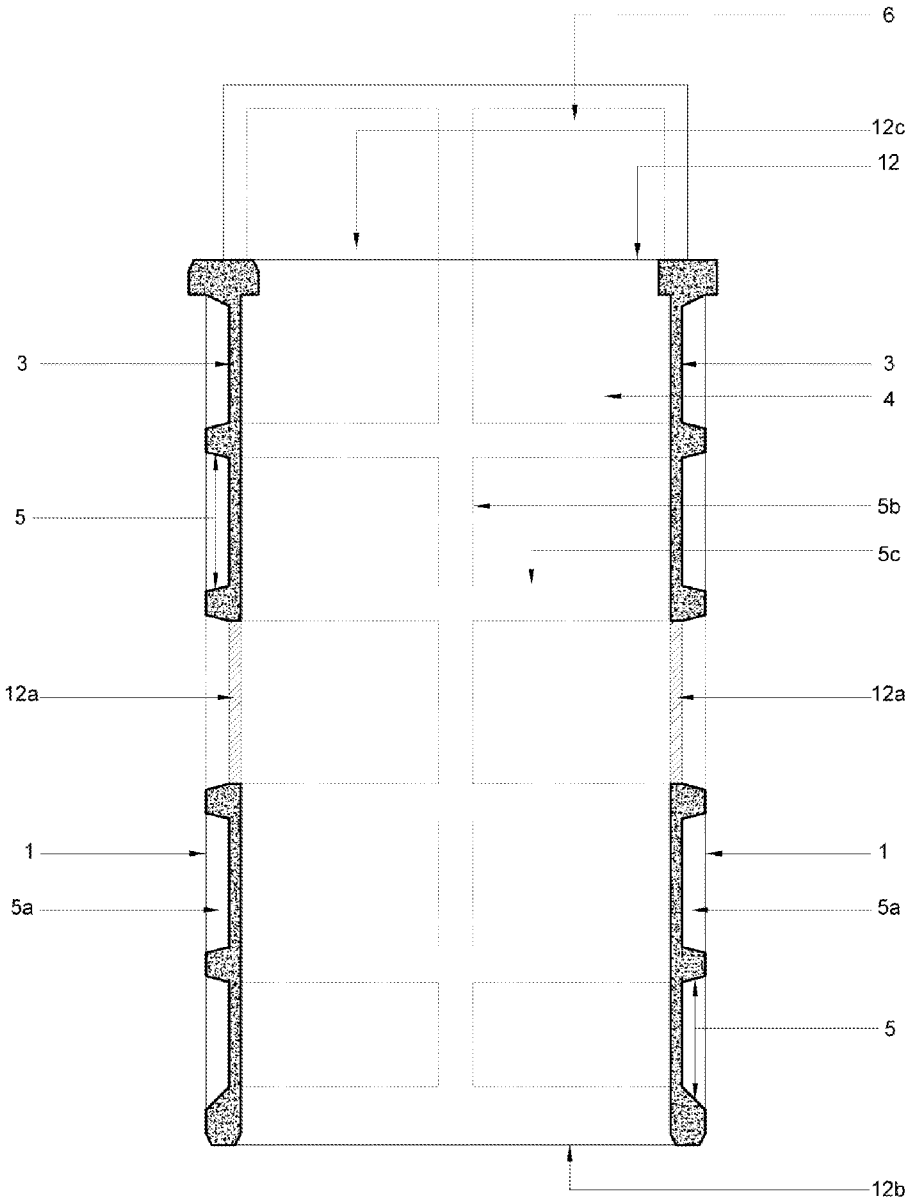
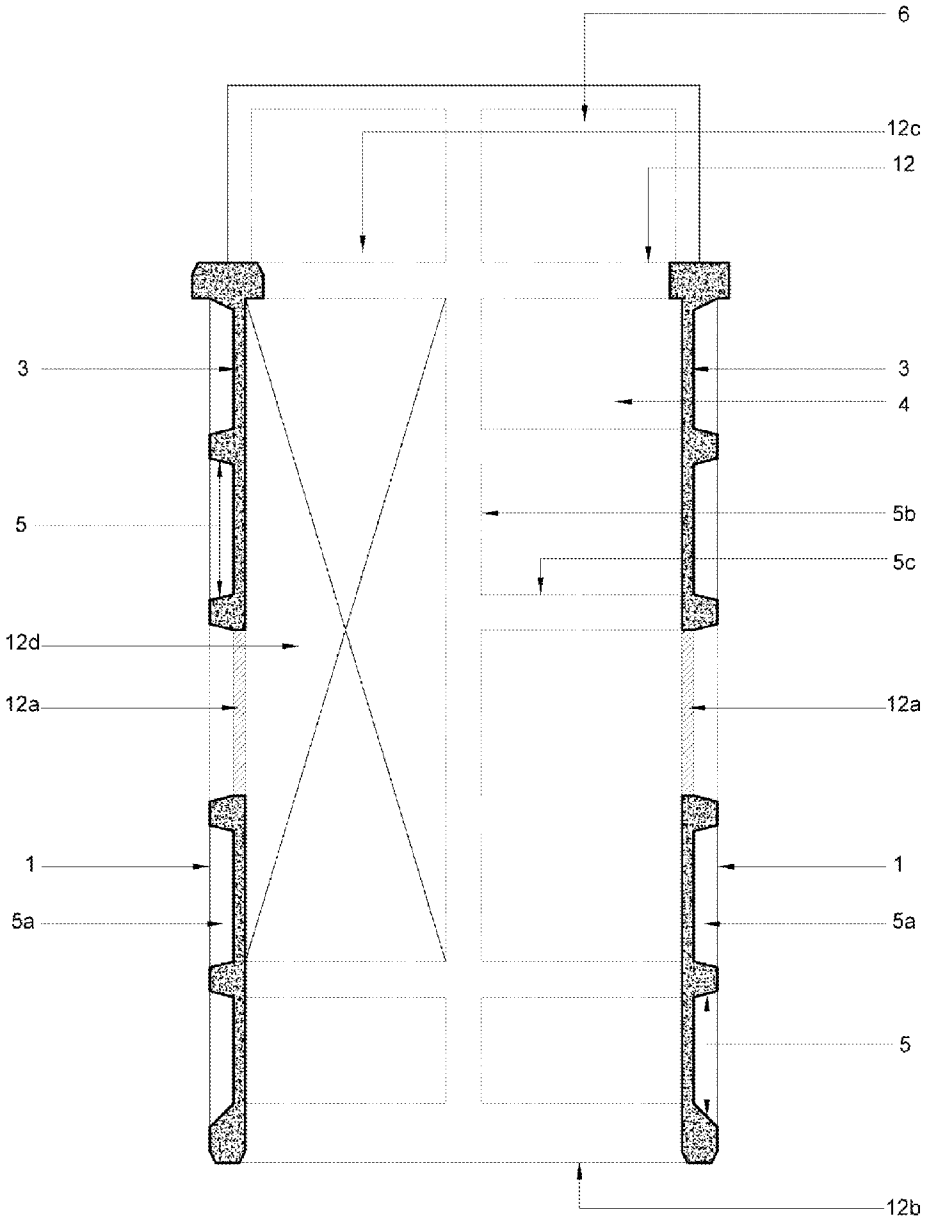


FIGURE 29a



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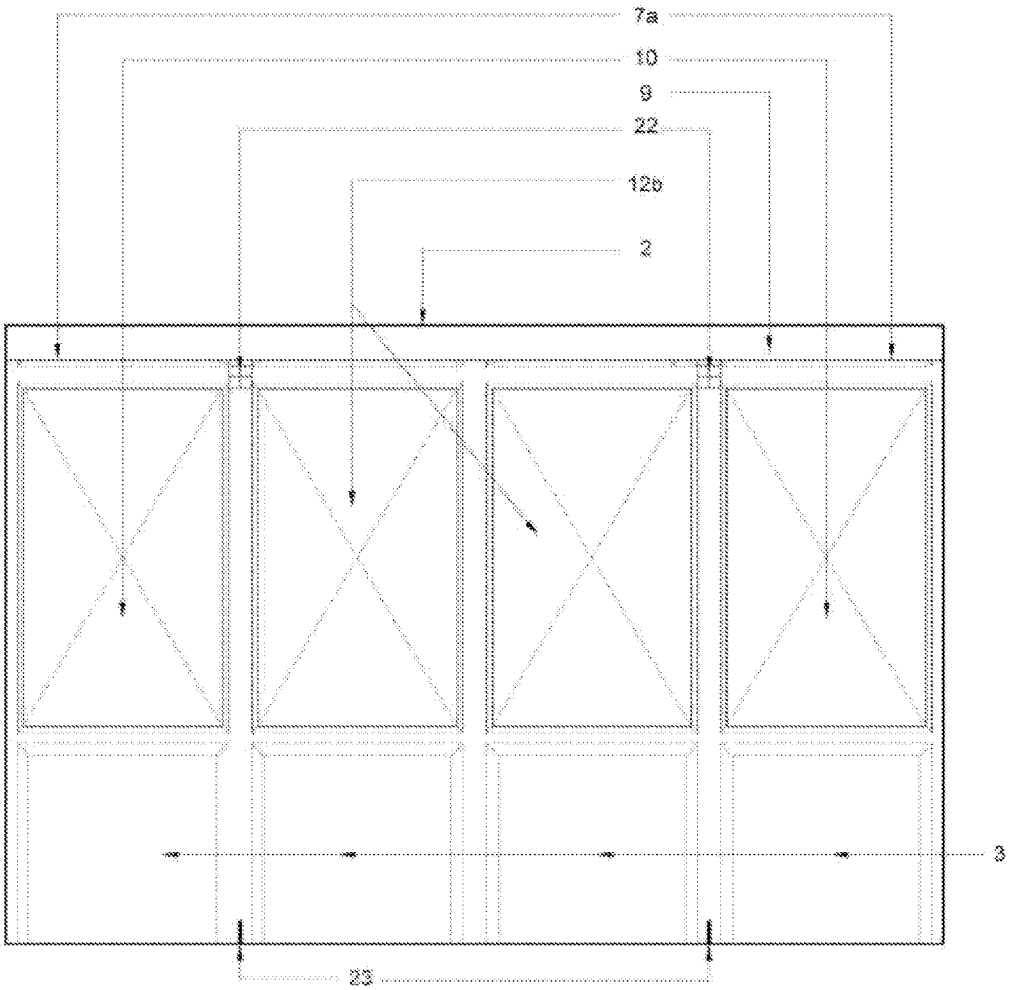

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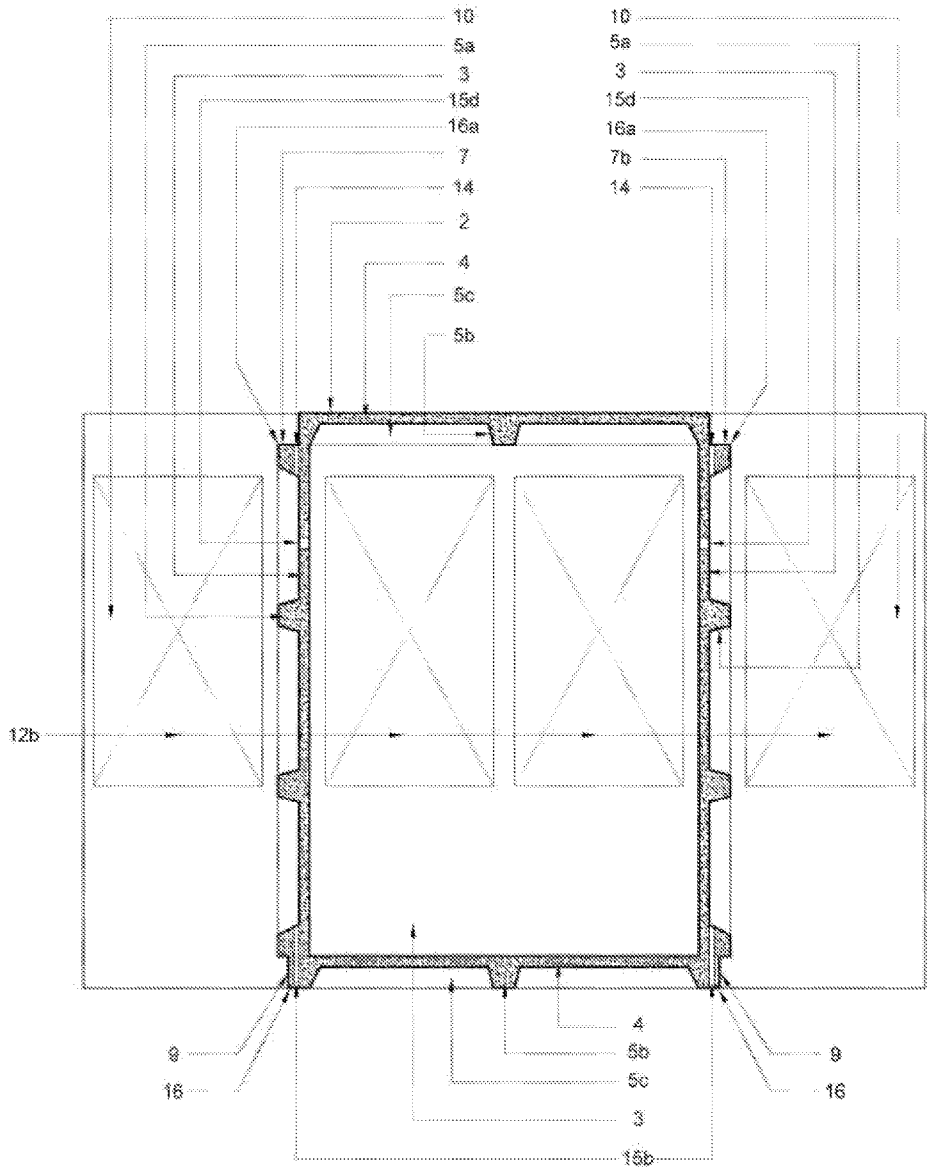
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FIGURE 31

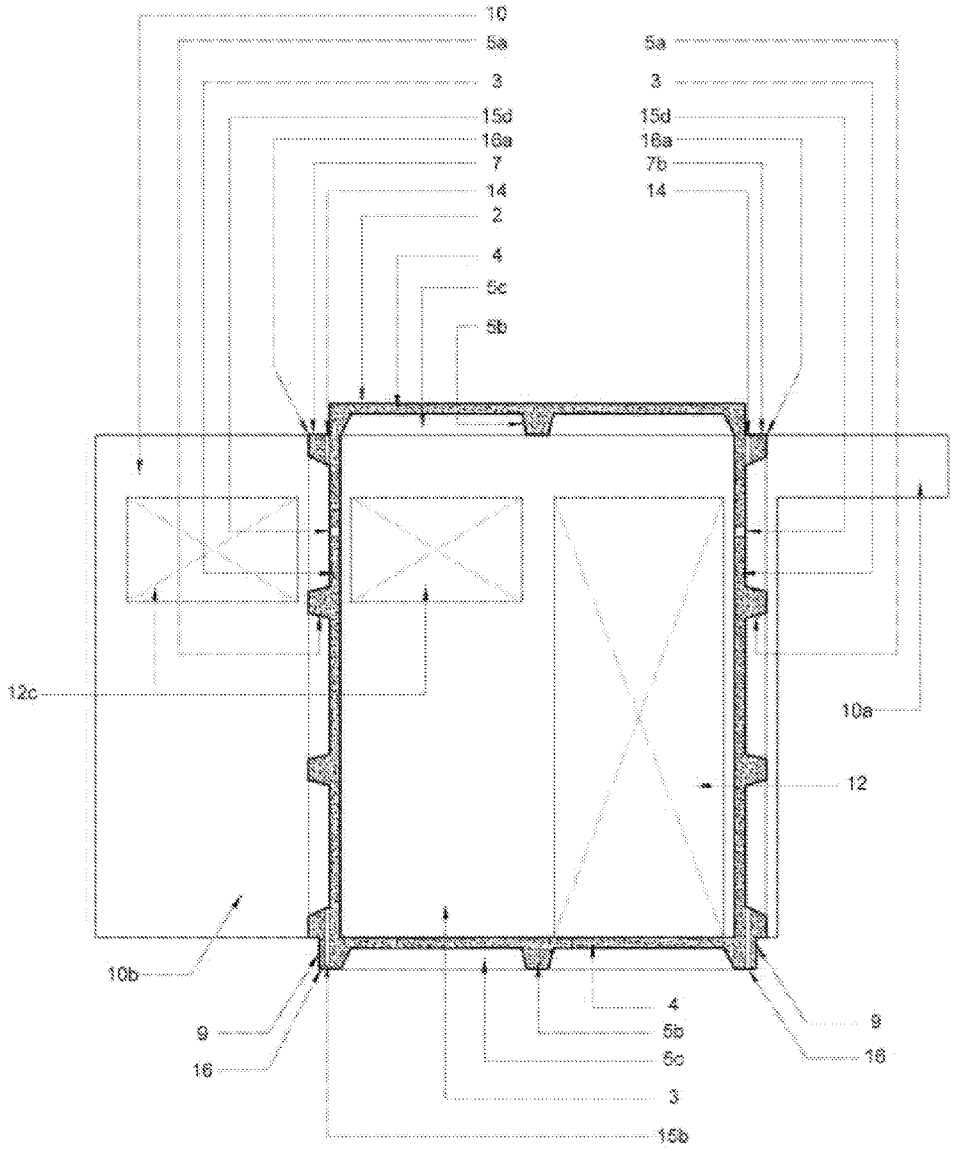
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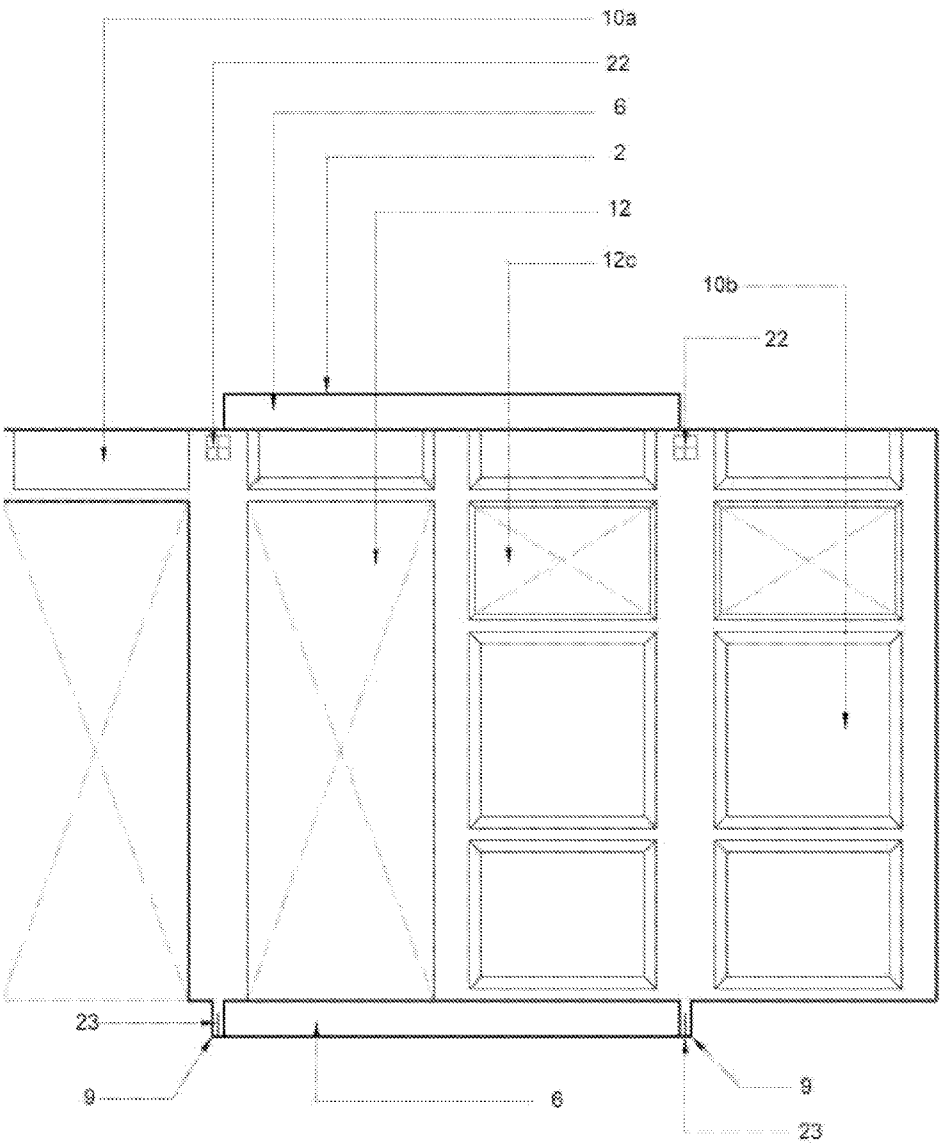
FIGURE 32



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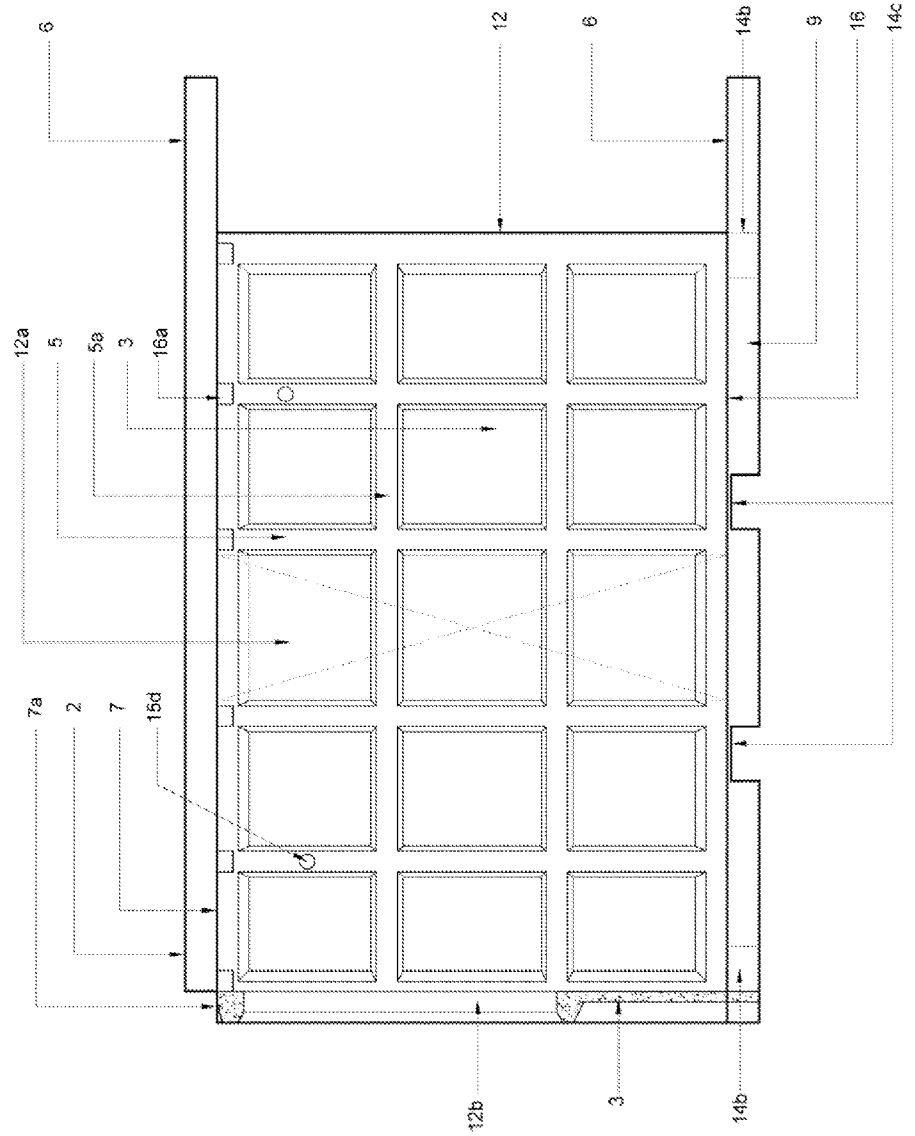

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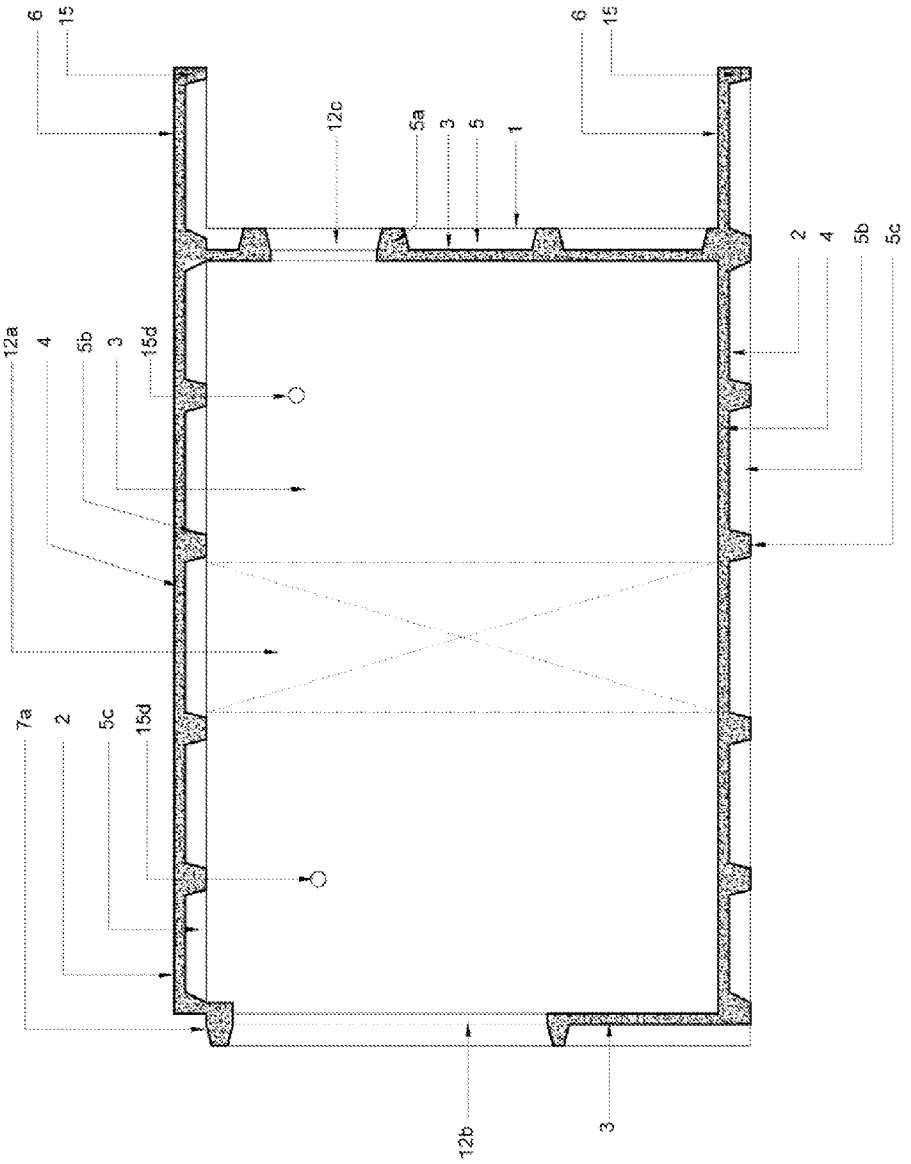


FIGURE 35

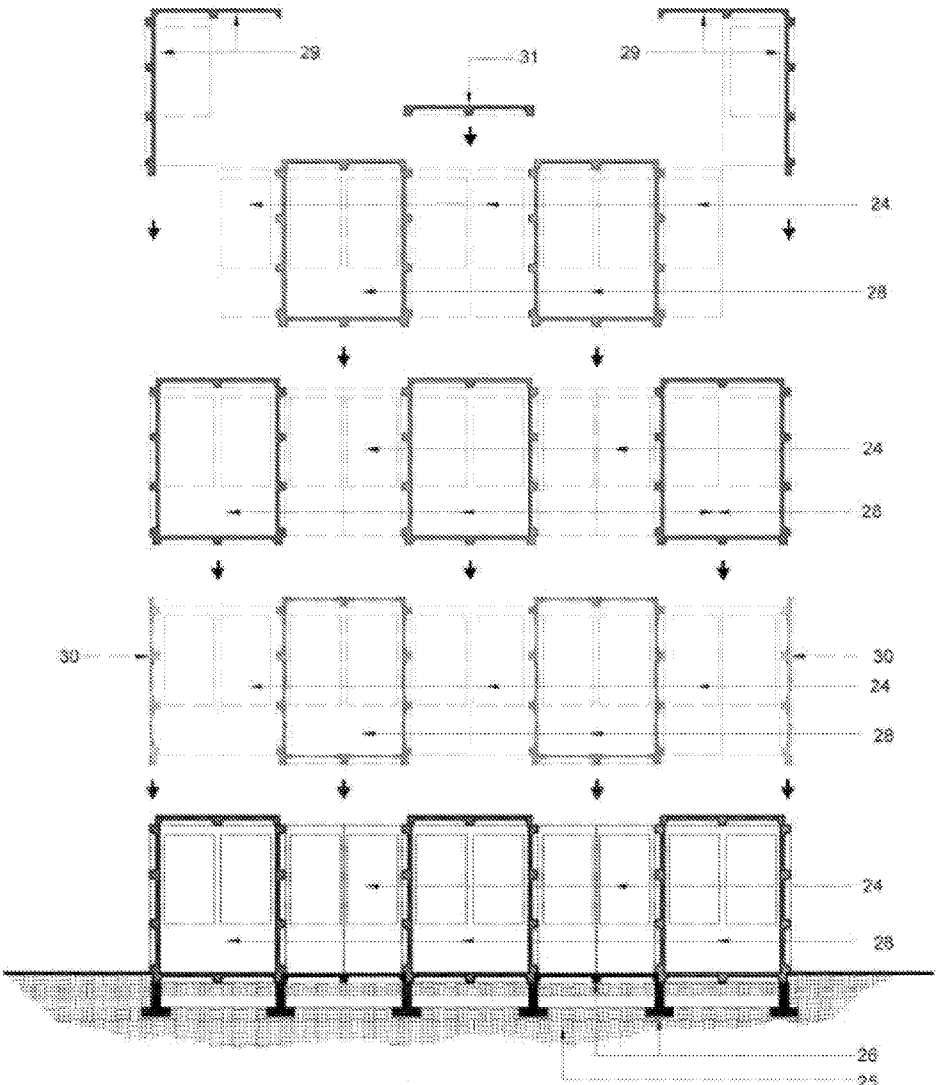
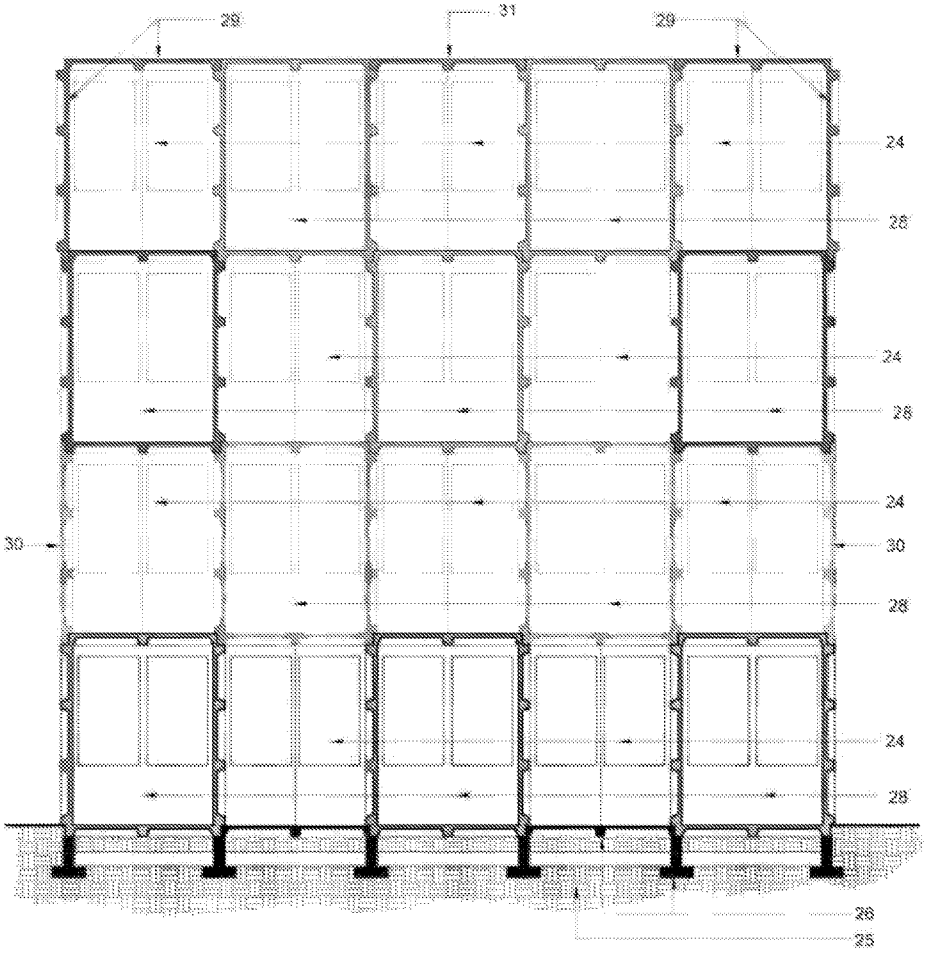


FIGURE 36



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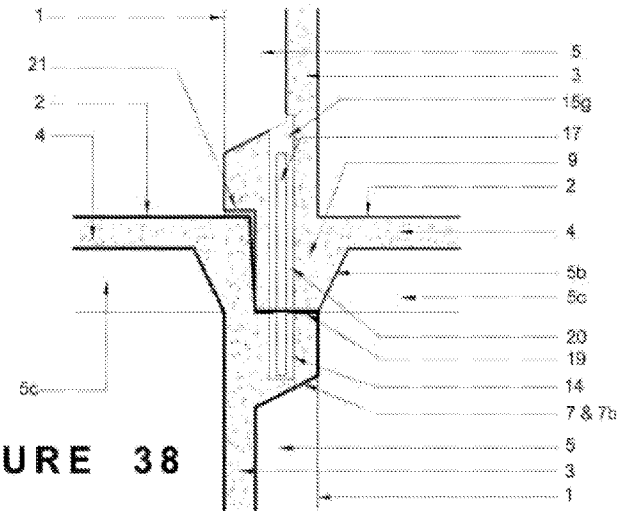


FIGURE 38

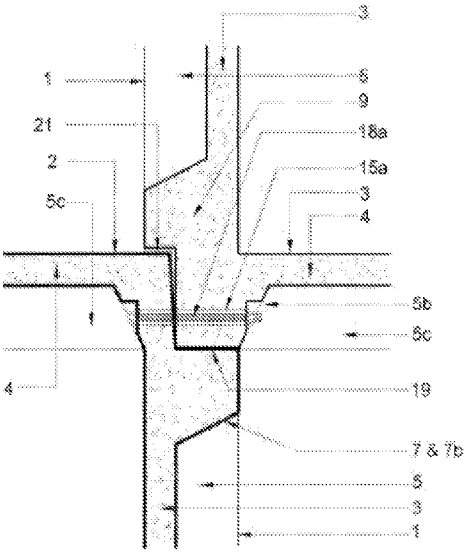


FIGURE 39

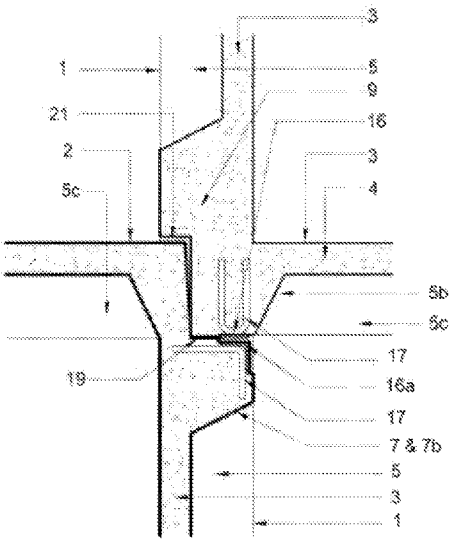


FIGURE 40

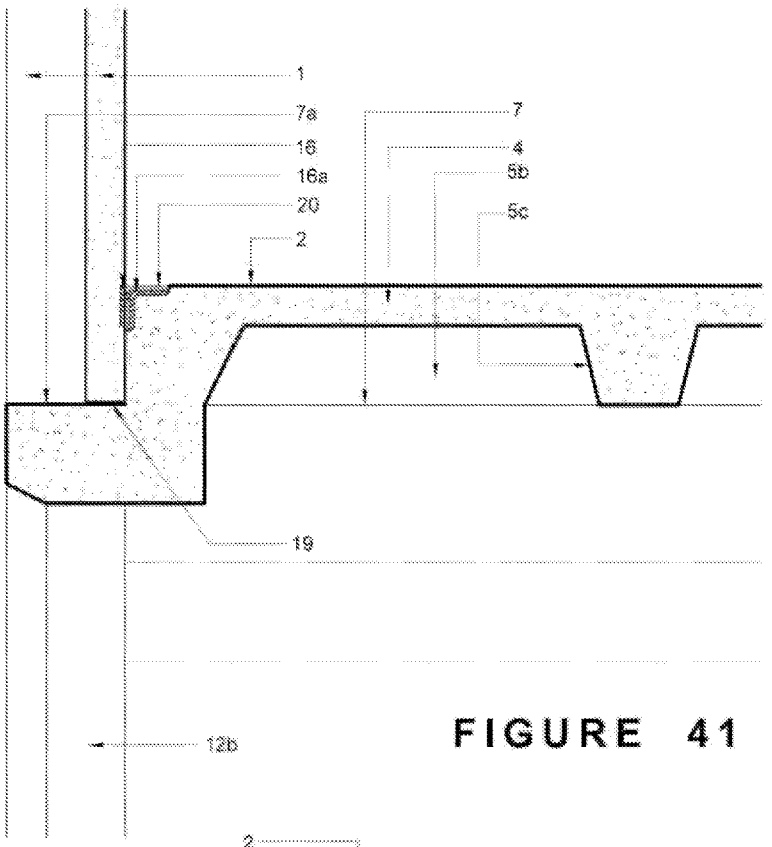
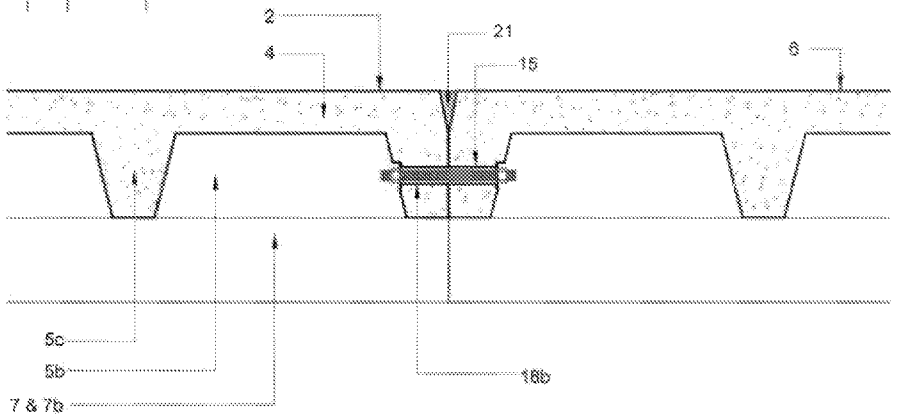


FIGURE 41



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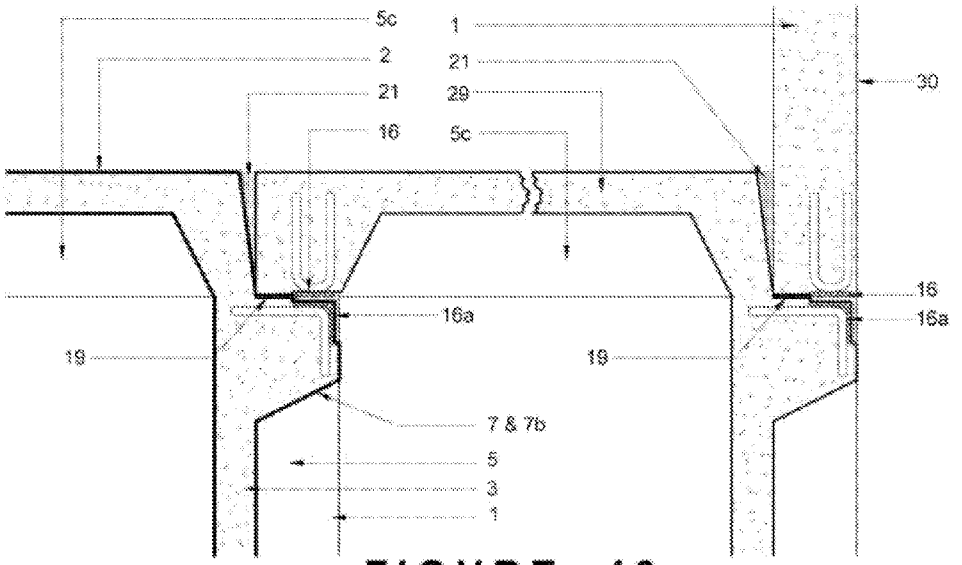

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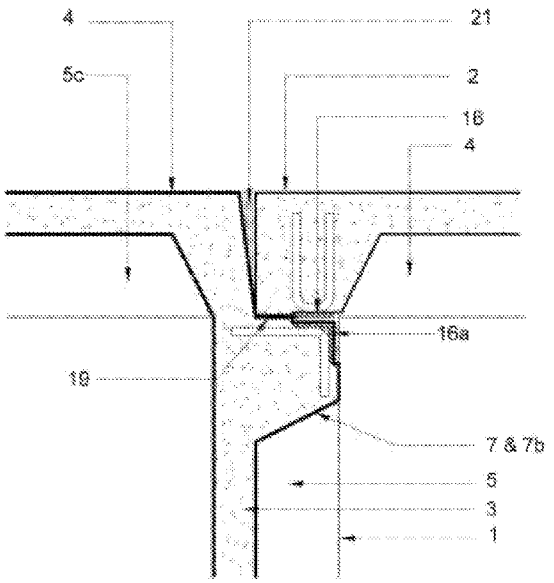

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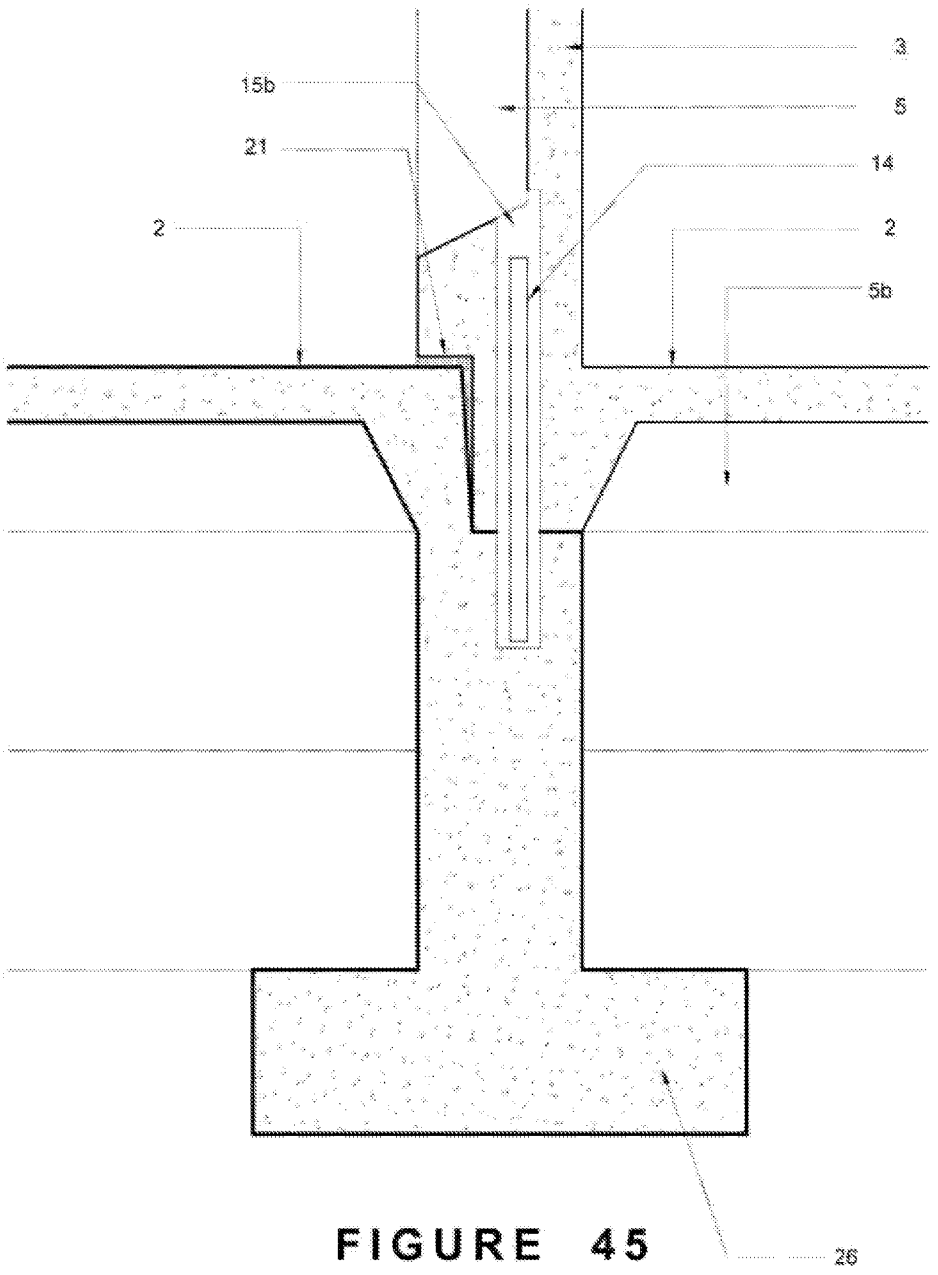

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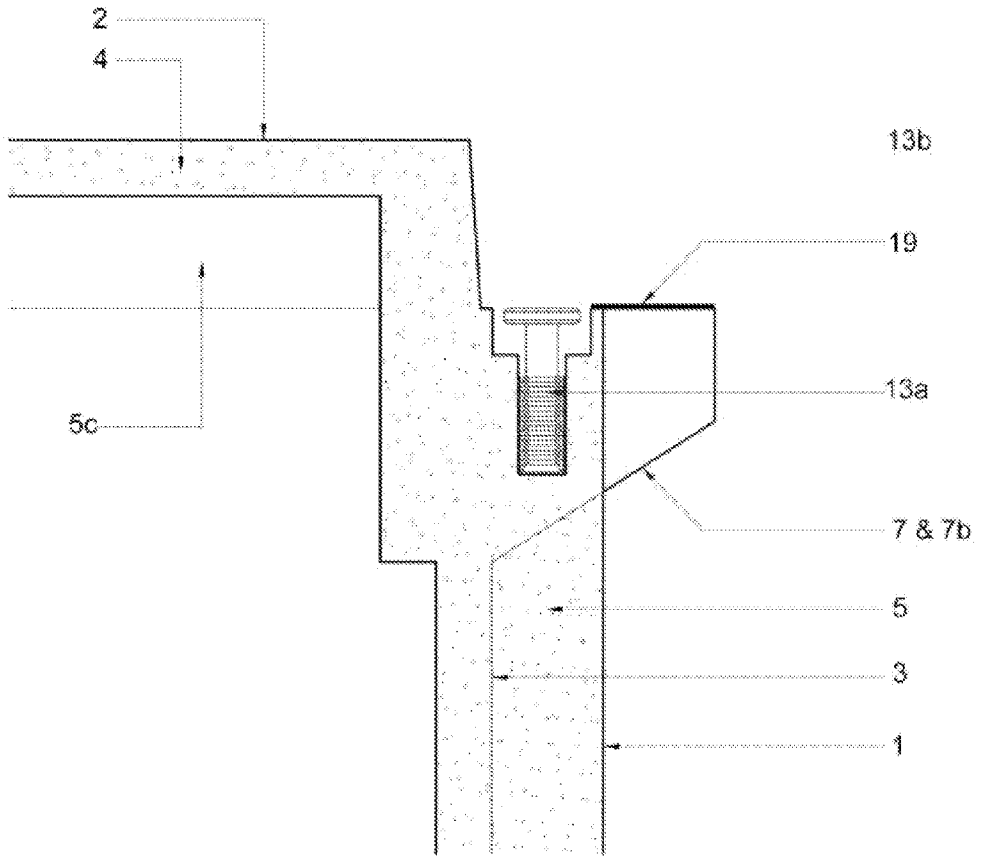
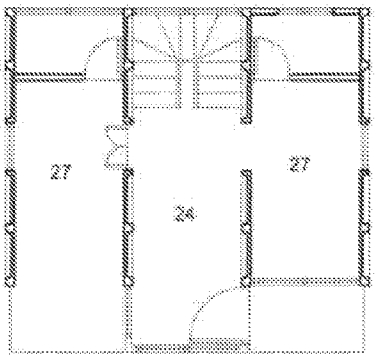


FIGURE 46



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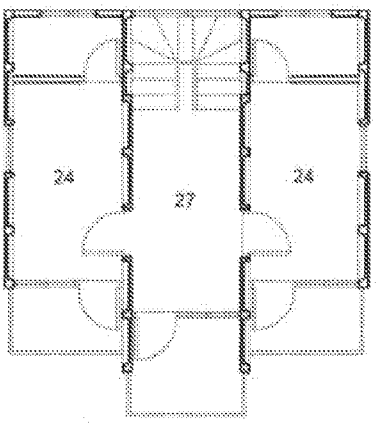
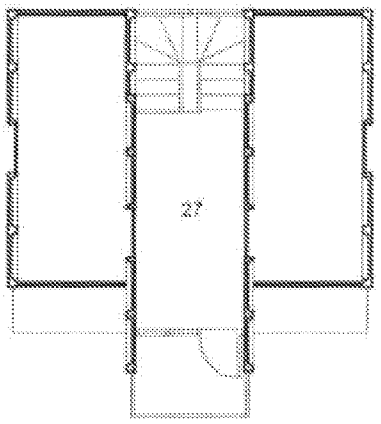


FIGURE 48



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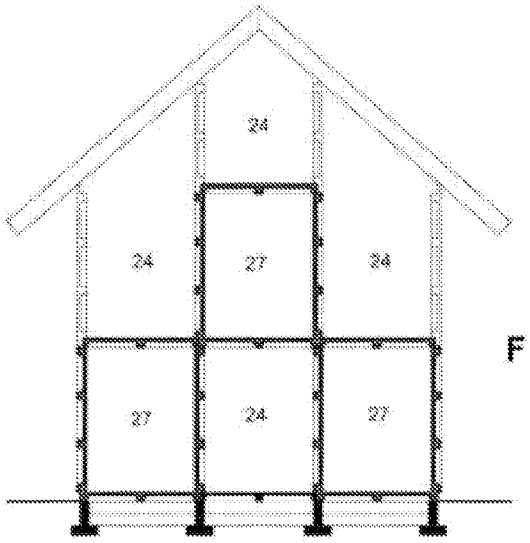


FIGURE 50

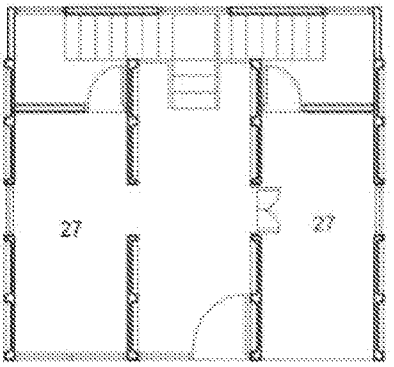


FIGURE 51

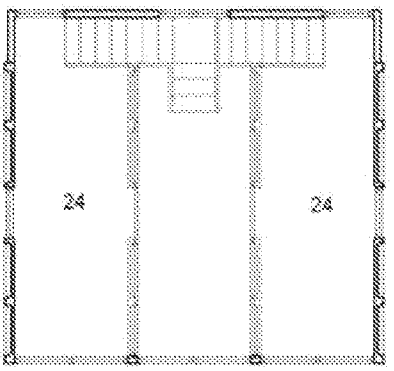
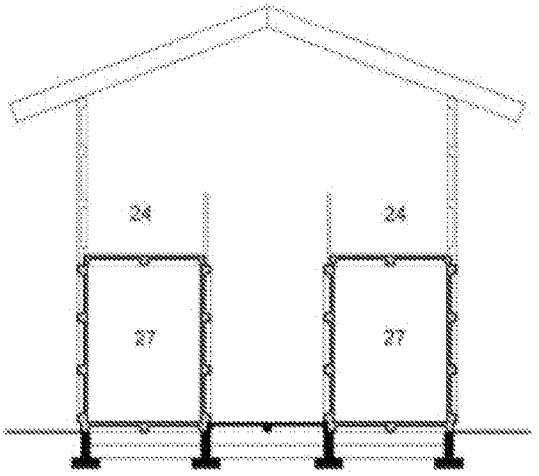


FIGURE 52



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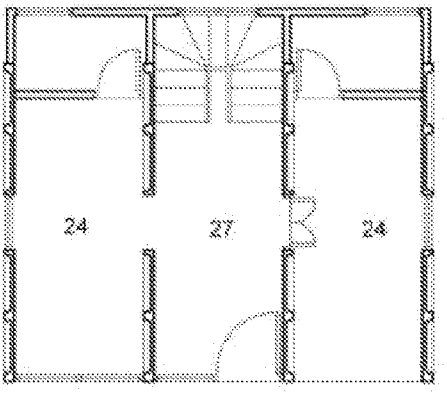

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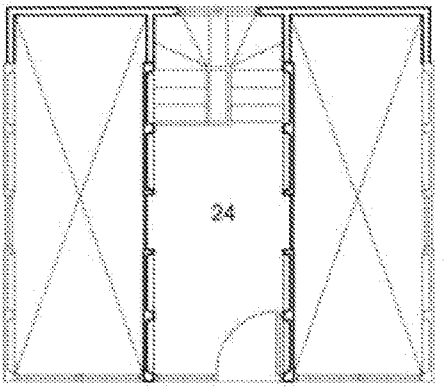

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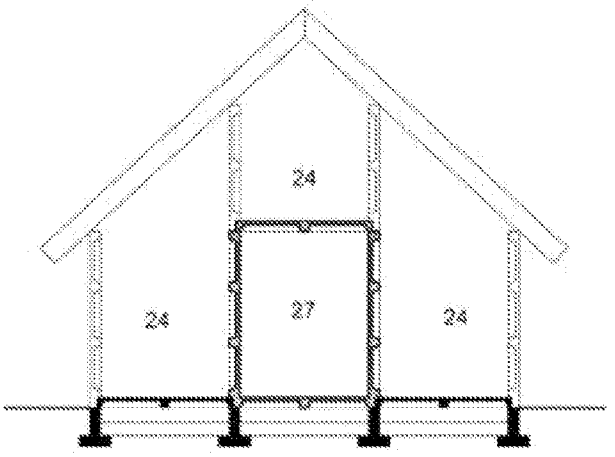


FIGURE 56

1	Waffle Wall
2	Waffle Slab
3	Wall
4	Slab
5	Rib (vertical)
5a	Rib (horizontal)
5b	Rib (longitudinal)
5c	Rib (transverse)
5d	Rib (diagonal)
6	Corridor/Horrizontal Wing
7	Corbel (right side)
7a	Corbel (front)
7b	Corbel (left side)
7c	Corbel (corridor)
7d	Corbel (slab)
8	Inverted Corbel
9	"Z" Corbel
10	Wing (front)
10a	Wing (corridor door)
10b	Wing (corridor window)
10c	Wing (corridor slab)
10d	Wing (left slab)
10e	Wing (right slab)
10f	Wing (left window sill)
10g	Wing (right window sill)
10h	Wing (middle window sill)
11	Connector Rib (corridor)
11a	Connector Rib (slab)
12	Opening (main door)
12a	Opening (side door)
12b	Opening (front window)
12c	Opening (corridor window)
12d	Opening (stair, airwell, elevator shaft, pipe chase)
12e	Opening (lower slab)
13	Lifting Rod/Hook
13a	Lifting Cylinder
13b	Lifting Bolt
14	Socket (corbel dowel)
14a	Socket (slab)
14b	Socket (hauling)
14c	Socket (fork lift)
14d	Socket (front corbel)
15	Hole (corridor)
15a	Hole (corbel side)
15b	Hole ("Z" corbel)
15c	Hole (slab)
15d	Hole (lifting)
15e	Hole (inverted corbel)
15f	Hole (end wall rib)
15g	Hole ("z" corbel)
16	Welding Plate/Anchorage
16a	Welding Angle/Anchorage
17	Dowel/Pin (rib)
17a	Dowel/Pin (slab)
17b	Dowel/Pin (inverted corbel)
18	Bolt (corridor rib)
18a	Bolt (corbel side/"Z" corbel)
18b	Bolt (slab)
18c	Bolt (waffle fence to pedestal)
19	Bearing/Rubber Pad
20	Grout
21	Sealant
22	Vertical/Horizontal Target
23	Match Grove
24	Extra Space
25	Engineered Soil
26	Waffle Slab and Foundation (for medium rise buildings)
26a	Stilt Foundation
27	Waffle Box
28	Waffle Box w/ Extended Wall Wing
29	Combined Waffle Wall & Slab
30	End Waffle Wall
31	Waffle Deck Slab
32	Waffle Box Code
33	Post-Tensioning Ducts (transverse sketching)
34	Post-Tensioning Ducts (longitudinal sketching)
35	Portal Frame
36	Enhancing (c.i.p. shear wall for medium rise bldgs)
37	Insulation
38	Waffle Fence
39	Precast Pedestal (for waffle fence)
40	Lower Precast Stair
41	Middle Precast Stair
42	Upper Precast Stair
43	Waffle Stair (2-storey houses)

FIGURE 57

FIGURE 57a

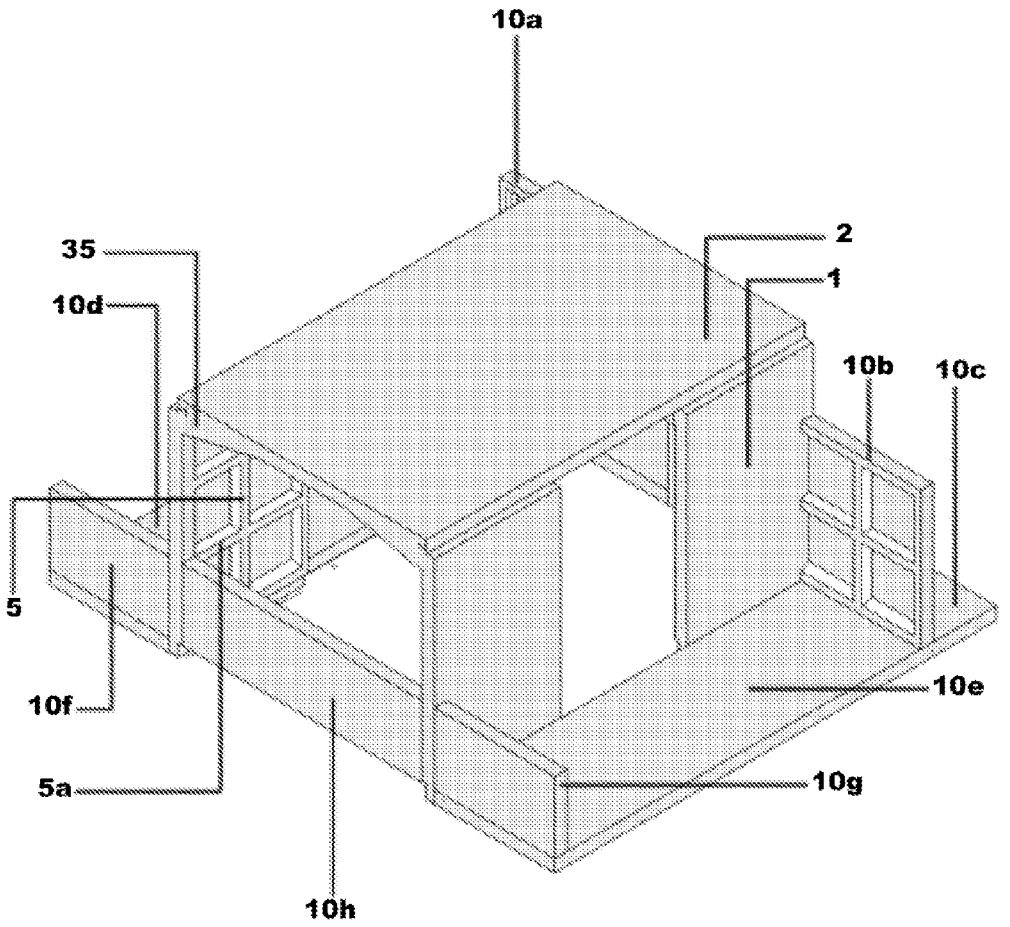


FIGURE 58

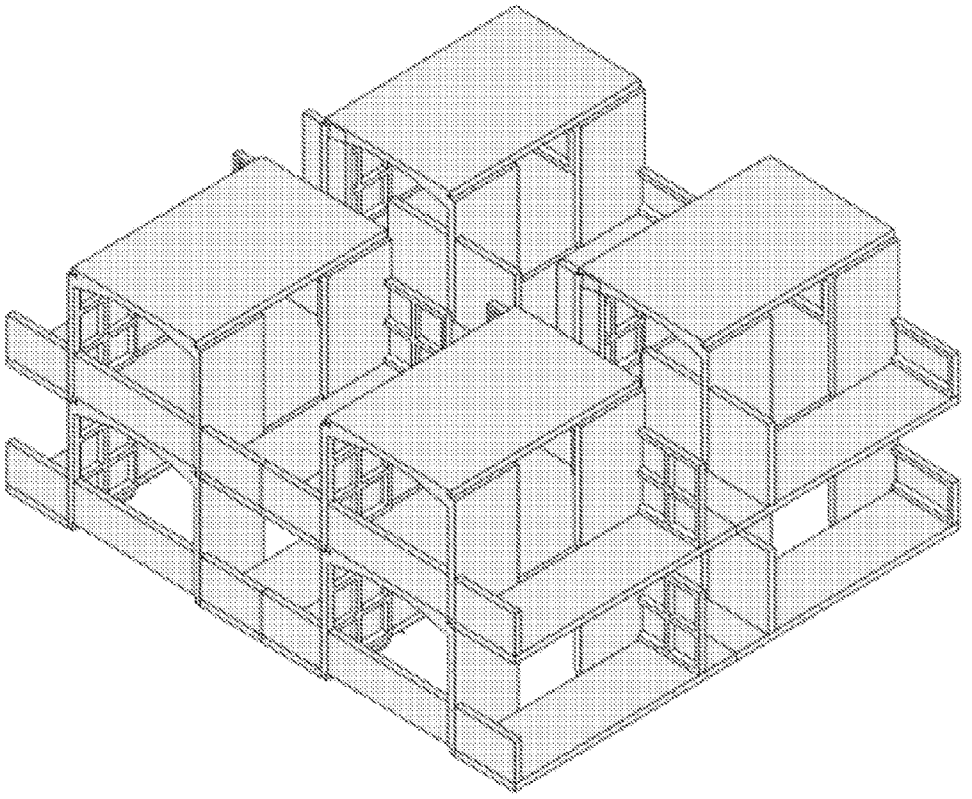


FIGURE 59

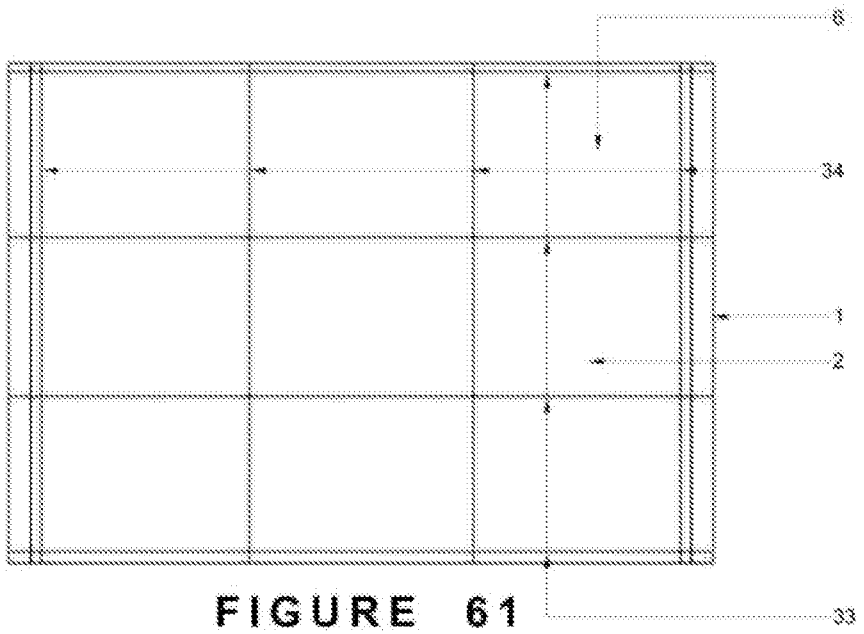


FIGURE 61

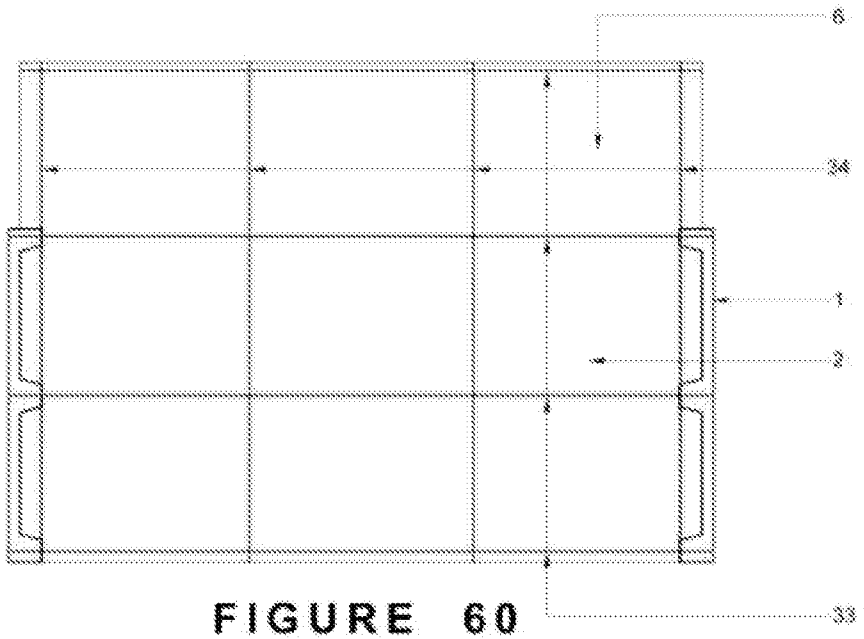


FIGURE 60

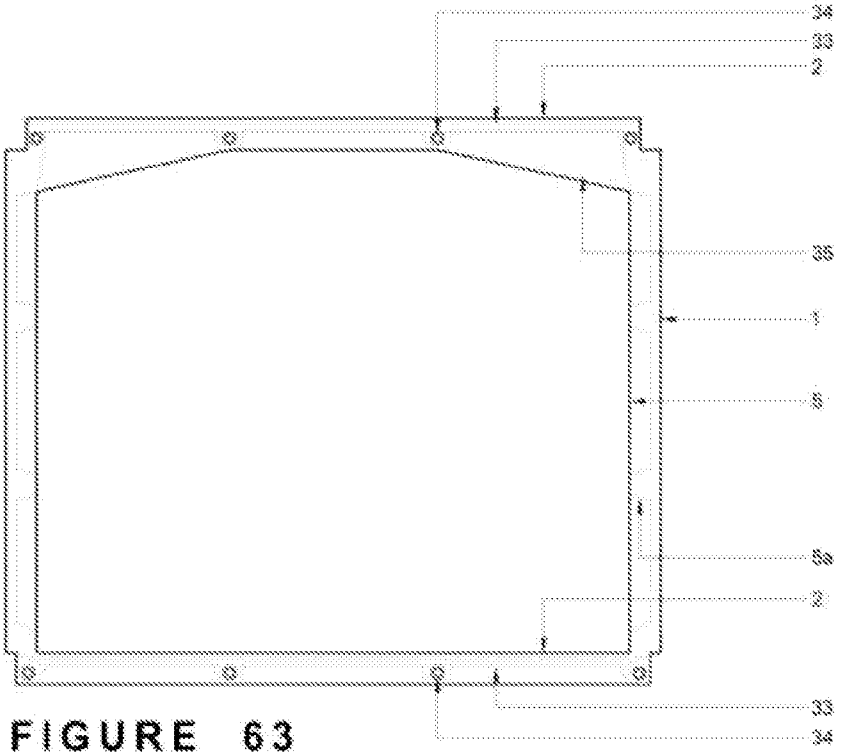


FIGURE 63

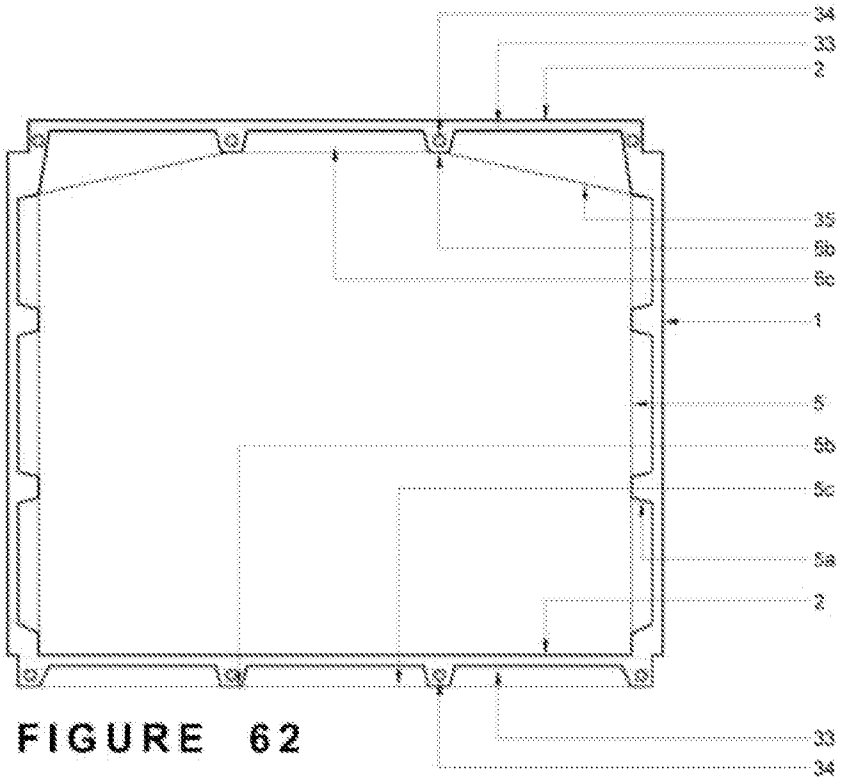


FIGURE 62

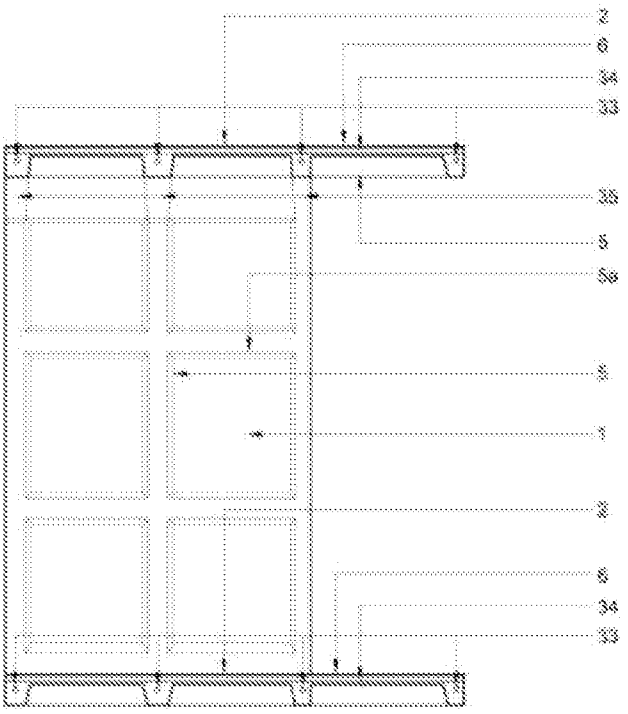


FIGURE 65

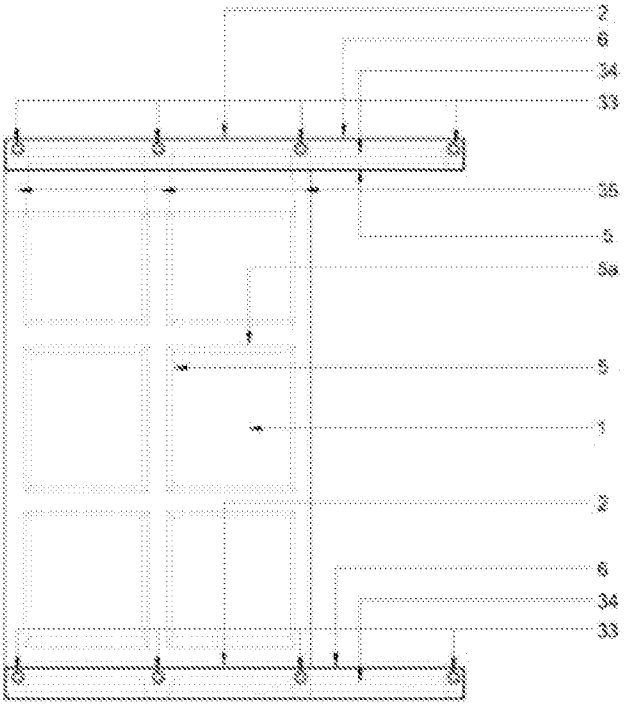


FIGURE 64

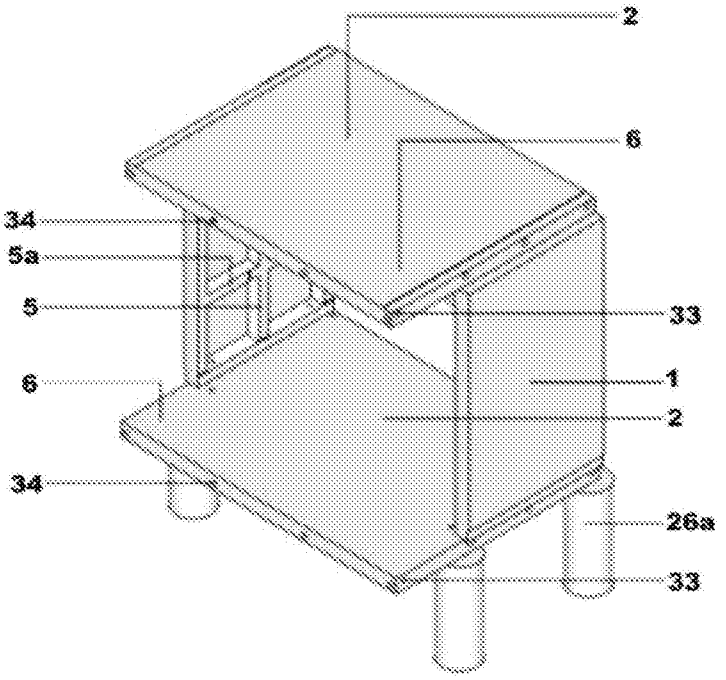


FIGURE 67

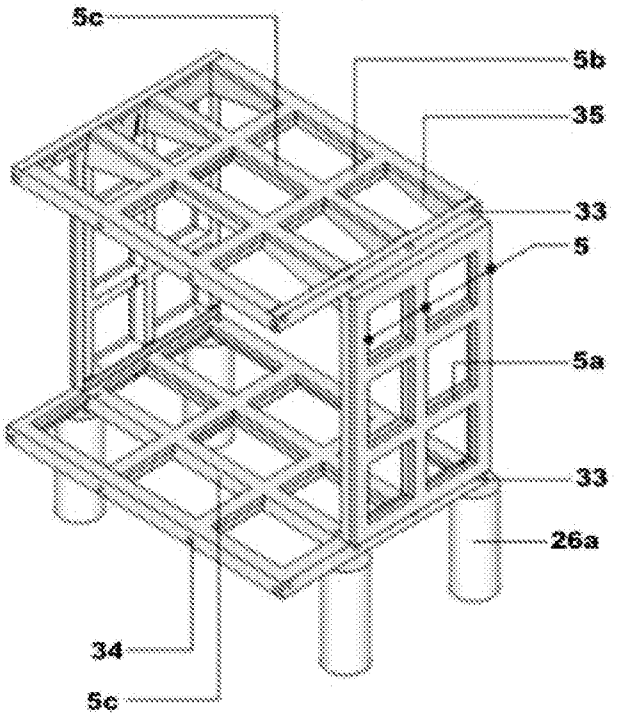


FIGURE 66

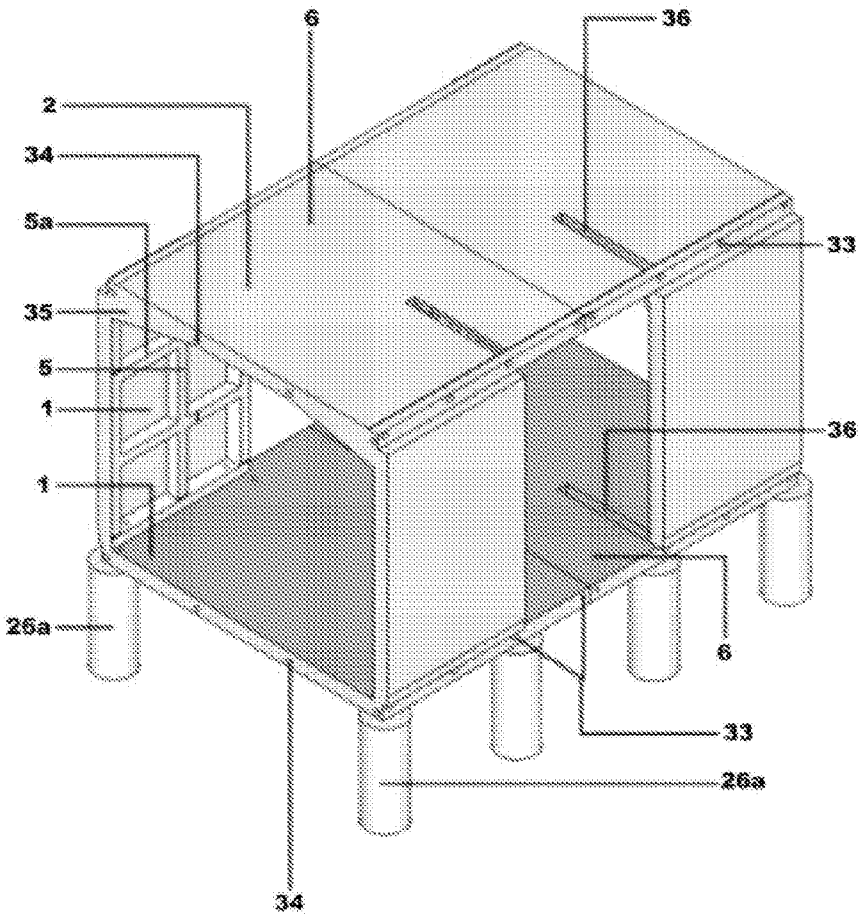


FIGURE 68

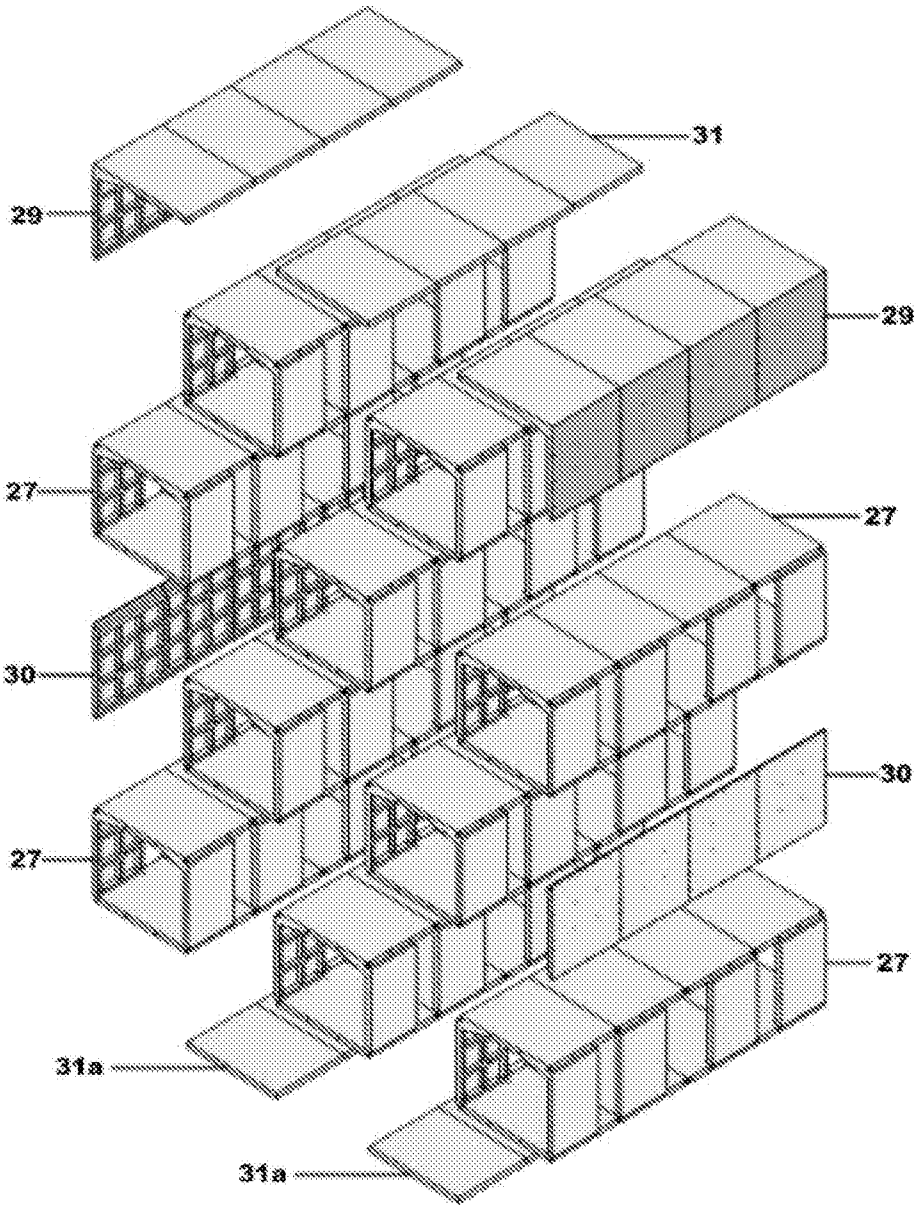


FIGURE 69

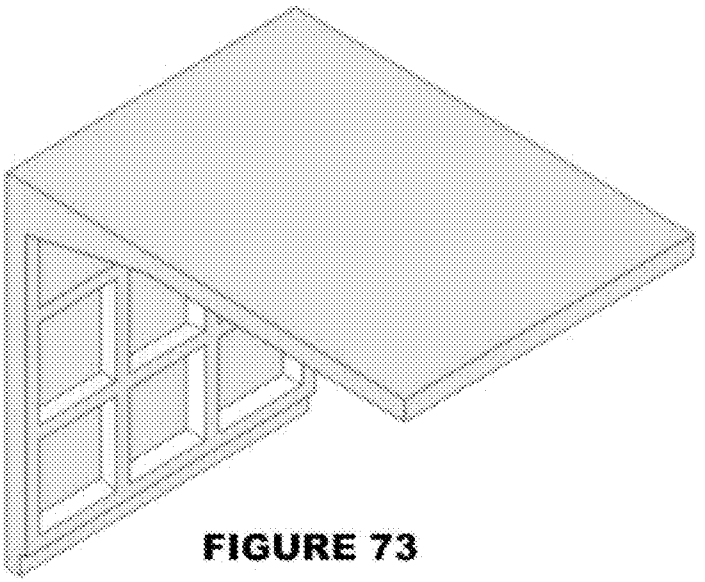


FIGURE 73

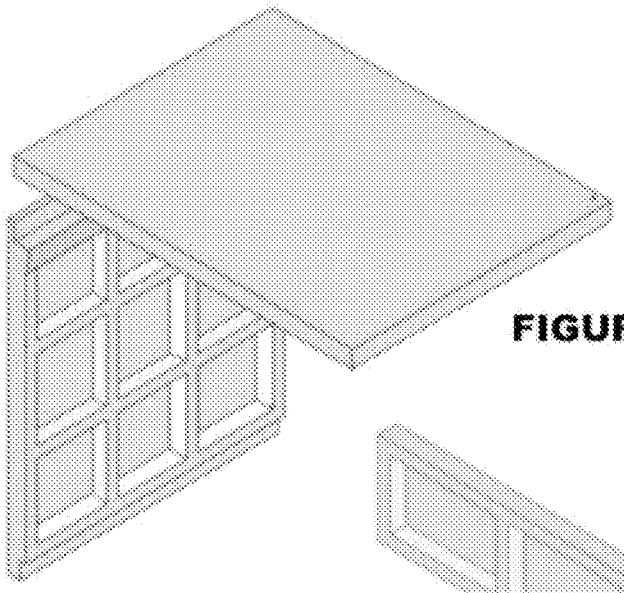


FIGURE 72

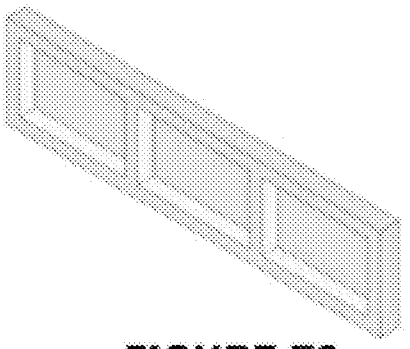
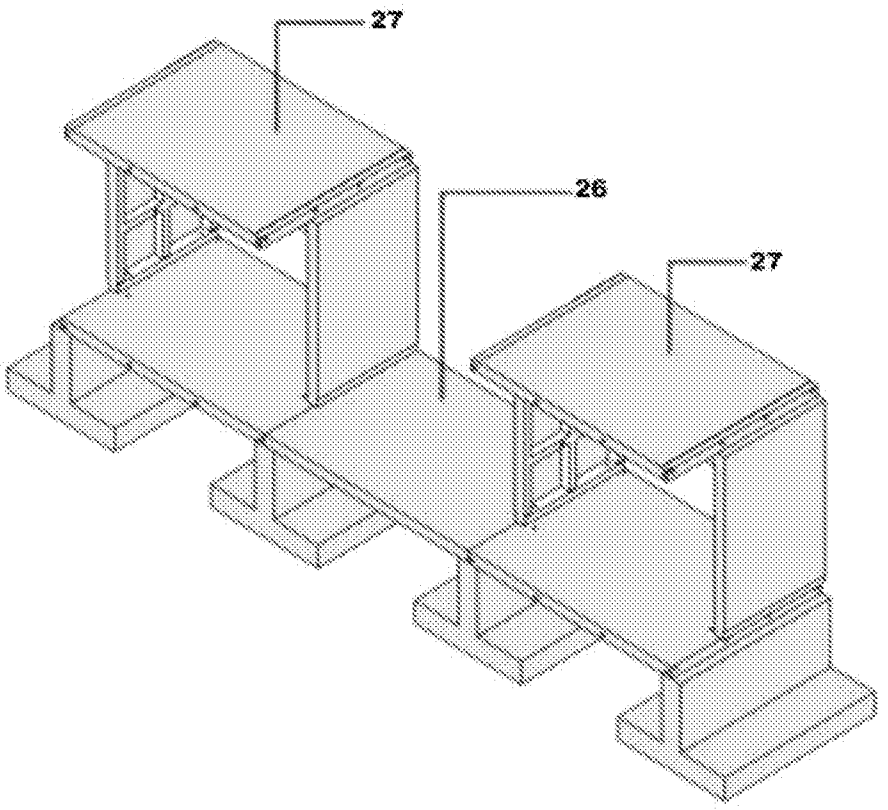


FIGURE 71

FIGURE 70



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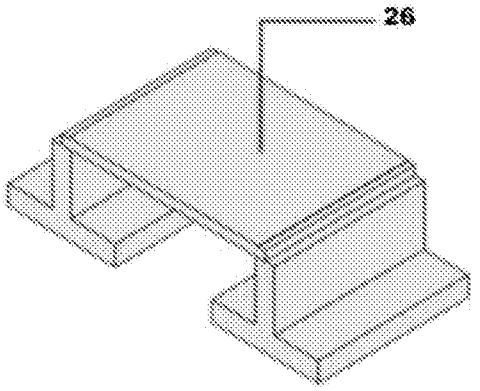
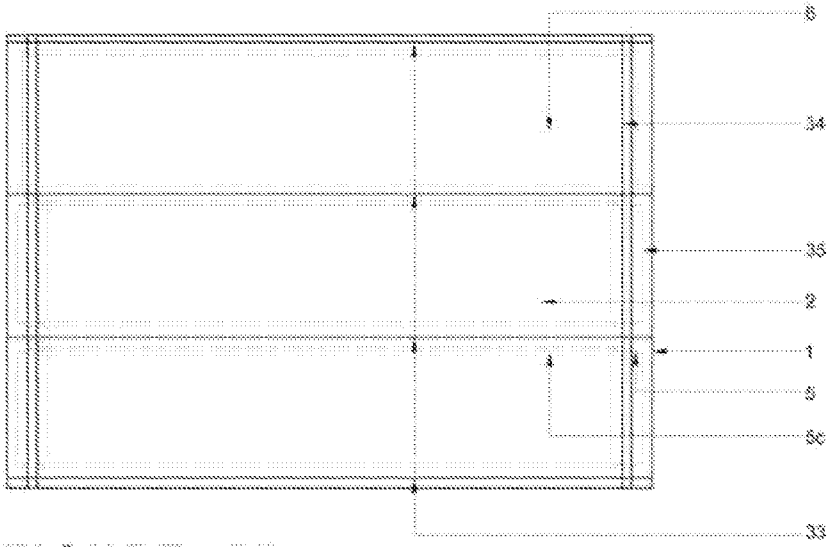


FIGURE 74



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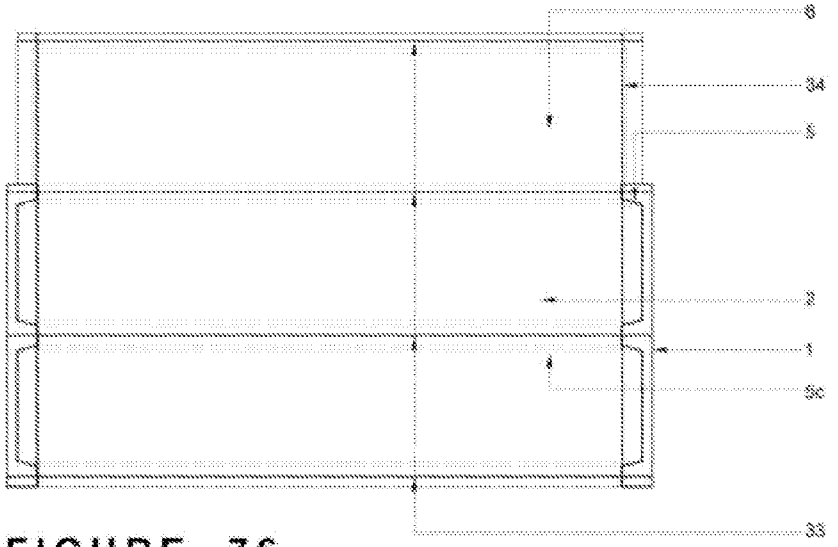

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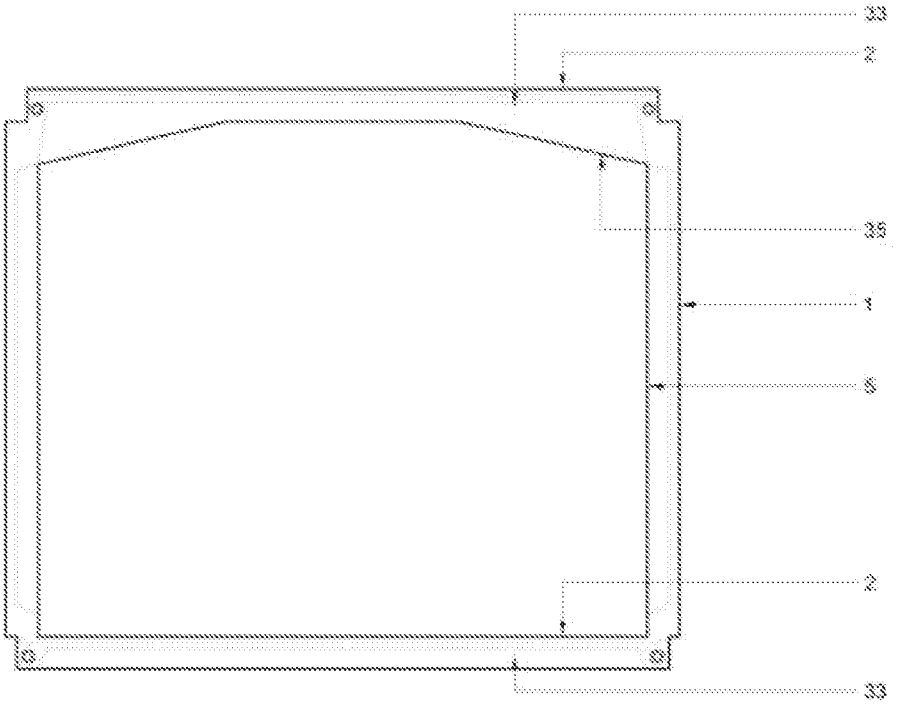

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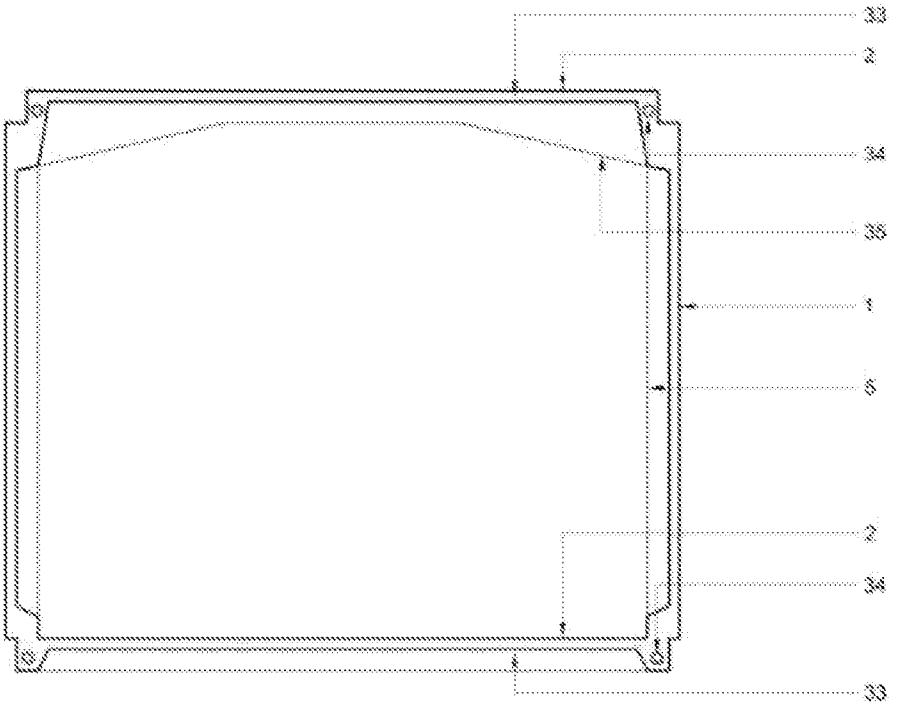

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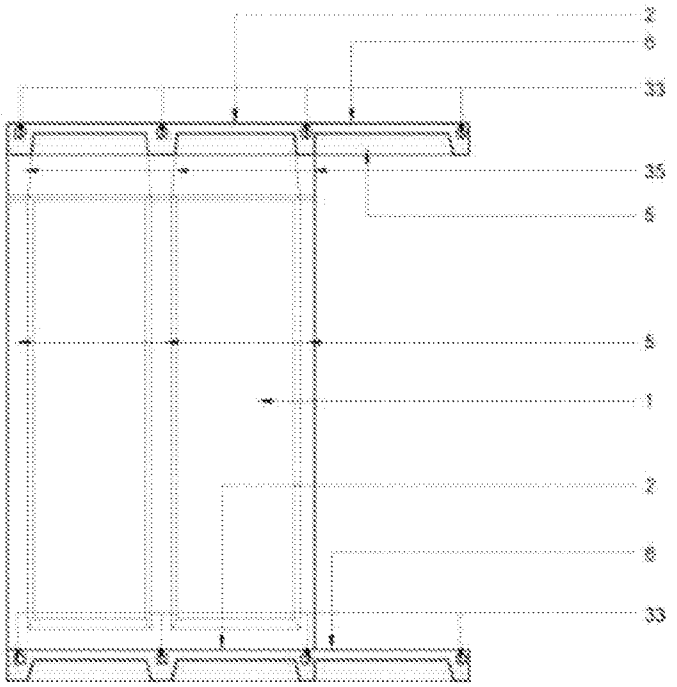

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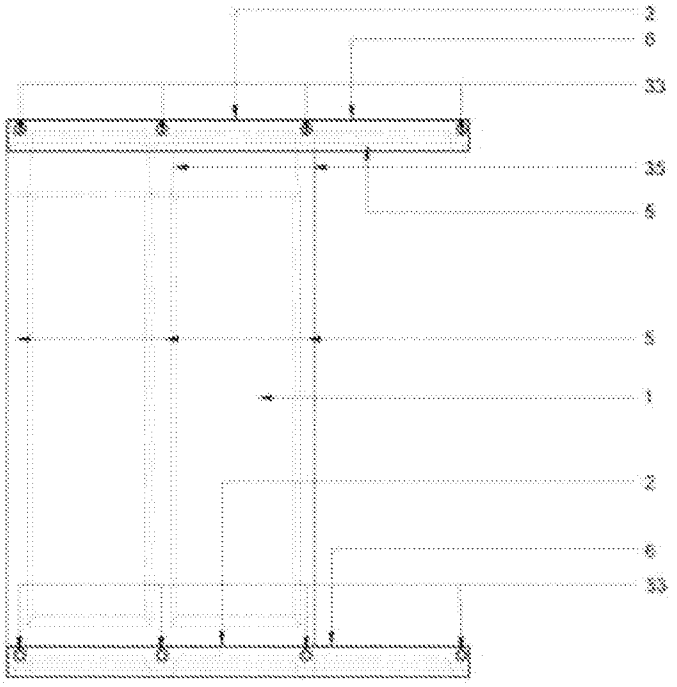

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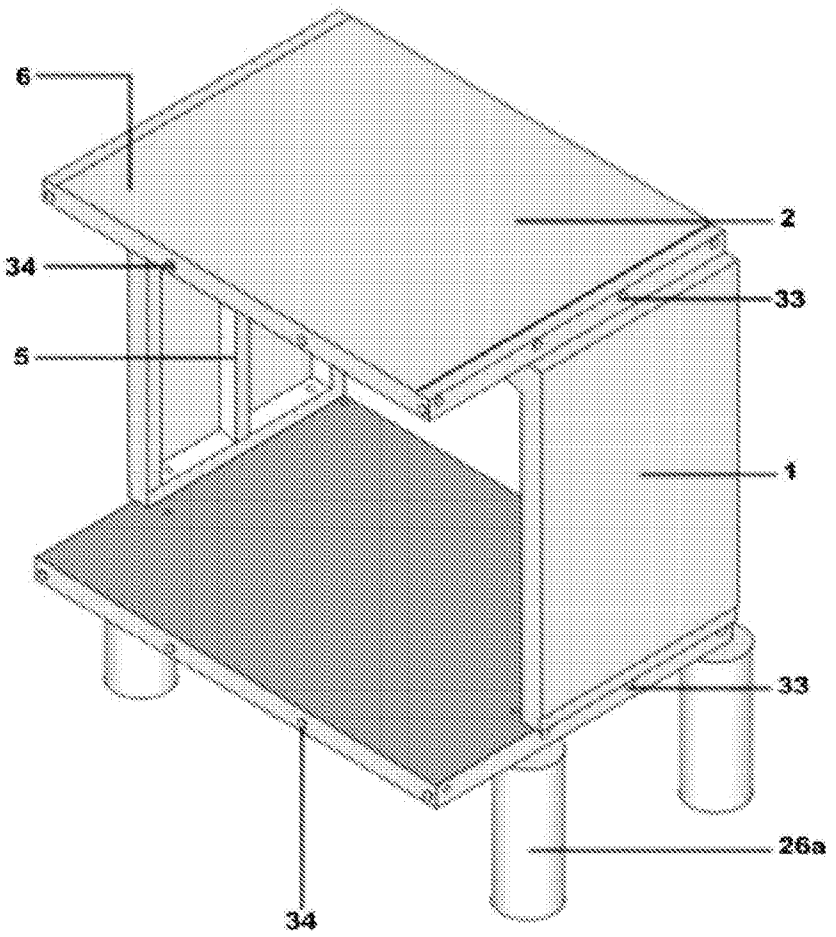

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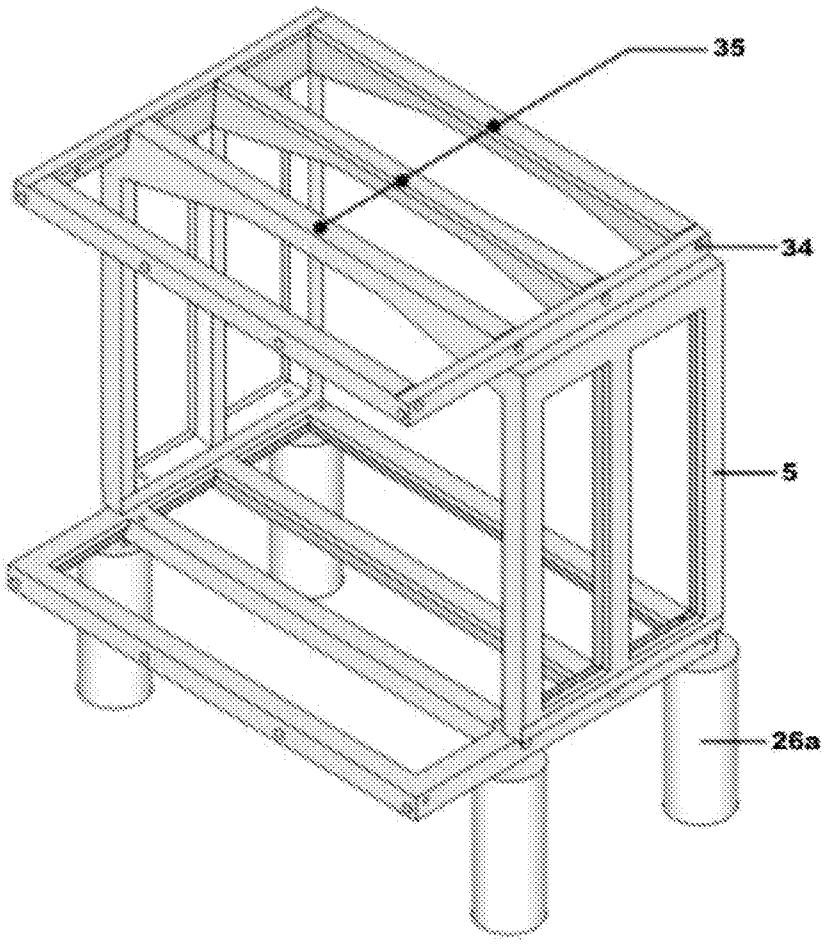


FIGURE 83

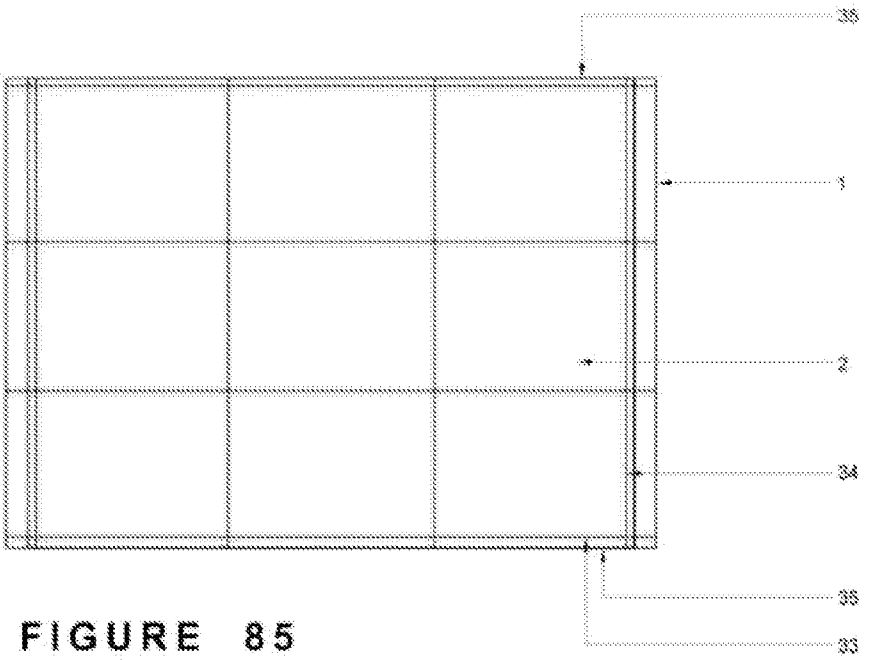


FIGURE 85

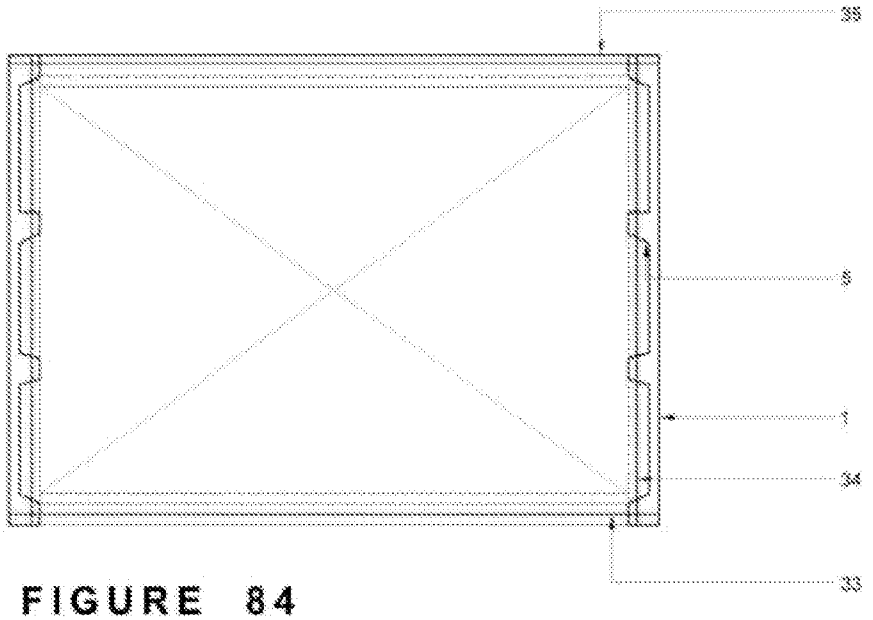
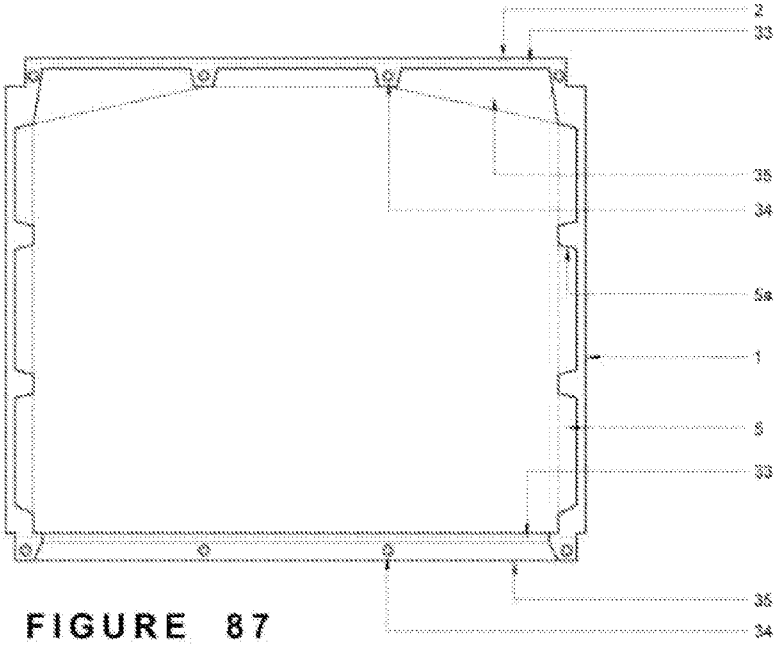


FIGURE 84



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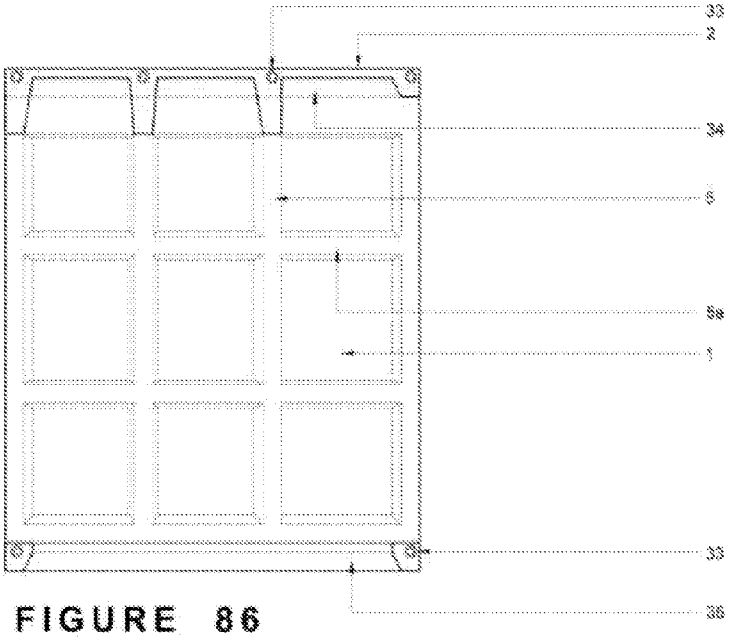

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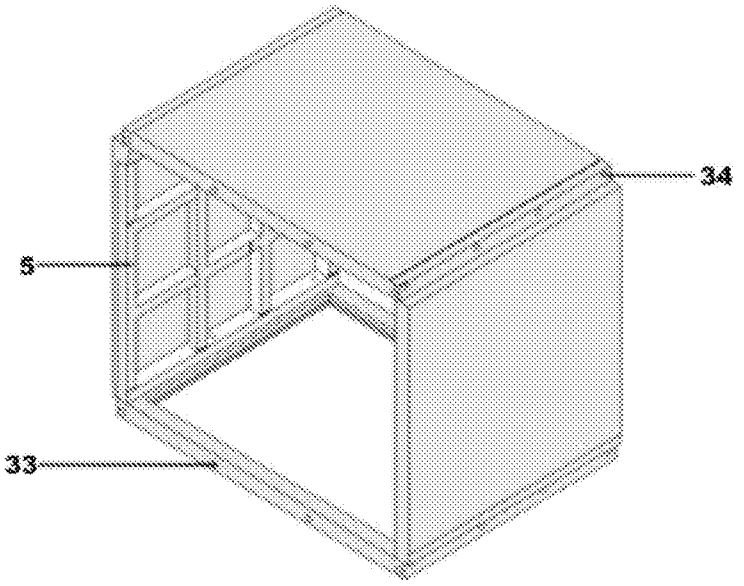

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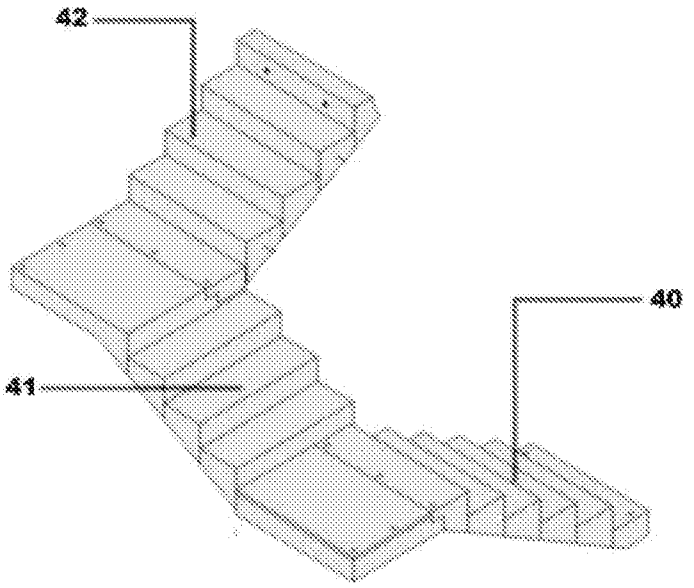

FIGURE 88

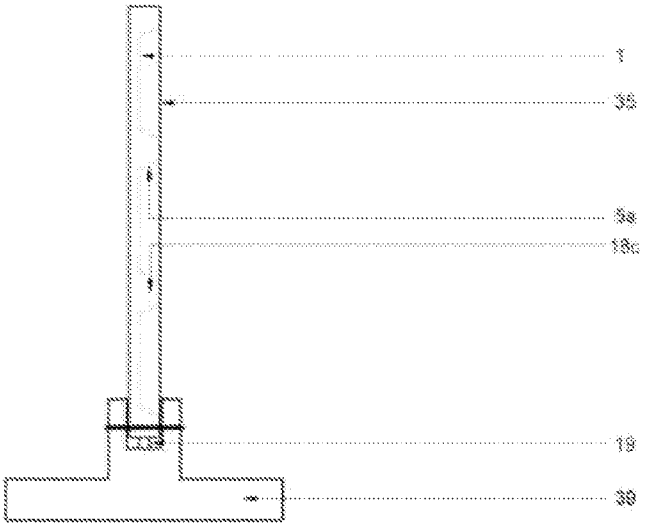

FIGURE 91

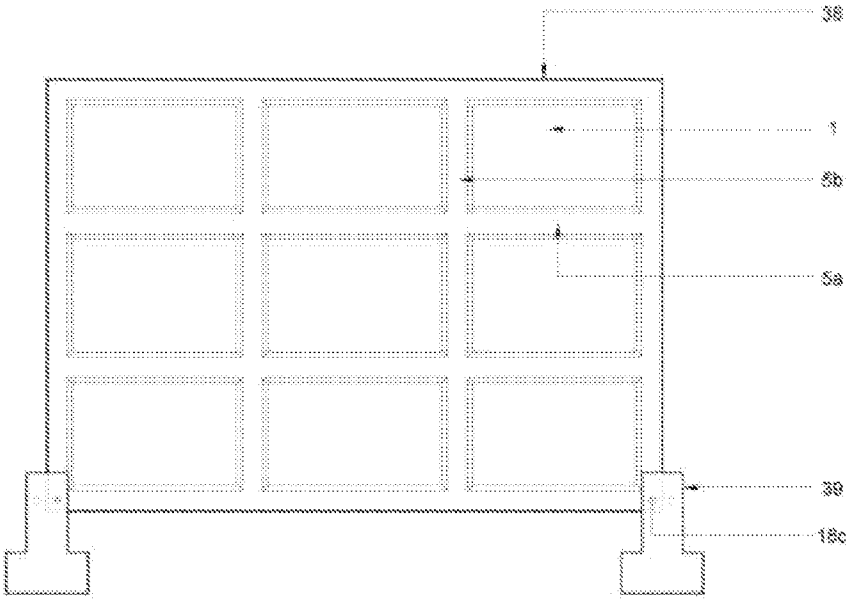

FIGURE 90

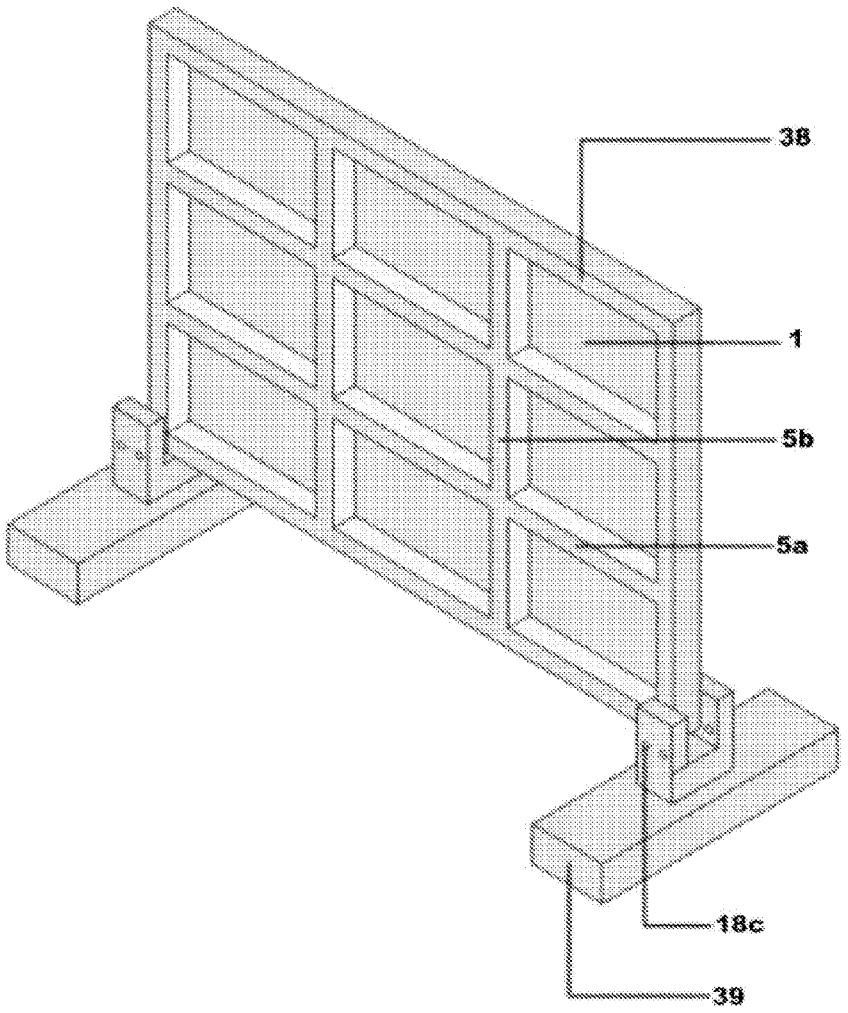

FIGURE 92

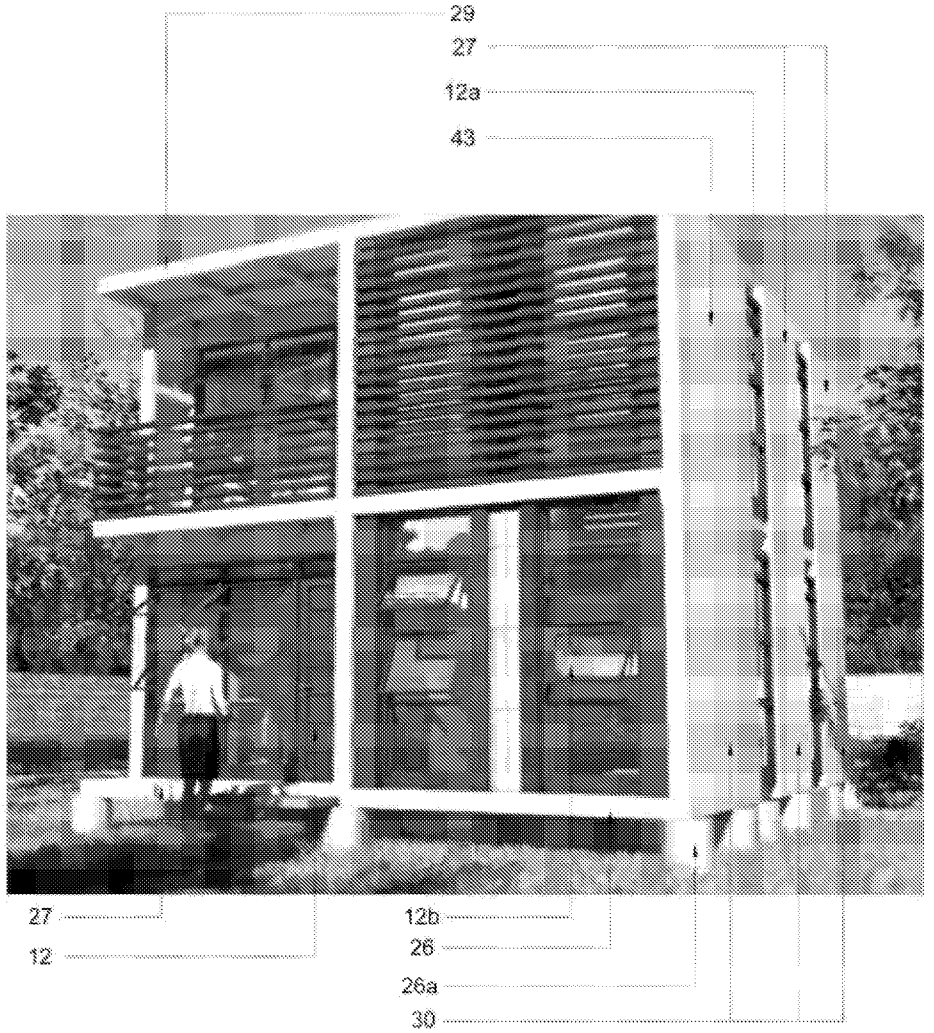

FIGURE 93

WAFFLE BOX BUILDING TECHNOLOGY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present Continuation in Part patent application is the National Phase filing under 35 U.S.C. 371 of the Philippine Application No.: 12012000216 entitled "Waffle Box Building Technology", filed 2012 Jul. 27 and International Application No.: PCT/PH2013/000002, entitled "Waffle Box Building Technology", filed 2013 Jan. 23.

RELATED CO-PENDING U.S. PATENT APPLICATIONS

[0002] No applicable.

FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0003] Not applicable.

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER LISTING APPENDIX

[0004] Not applicable.

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BACKGROUND OF THE INVENTION

[0006] In reference to the prior art or Philippine Utility Model Registration No. 2-2001-000254 issued on May 19, 2005, with the Title: A Modular Wall Panel for Fence, Housing, or Building Units and Maker: Claude Edwin Andrews of Mandaluyong City, Philippines, the precast modular panels as claimed, are laid horizontally with poured concrete between joints. The same modular panels are laid piece by piece with some panels having tongue and grove to complete a certain height or length. It is noted in this prior art that the panel indentations are strictly around the perimeter edges.

[0007] The Philippine Utility Model Registration No. 2-2001-000254 is a useful model and a good contribution in the construction industry as a whole. This waffle box **27** invention defines a very specific thin wall **3** or slab **4** (sometimes called skin) with a series of orthogonal indentations on one of the faces called ribs **5** (FIGS. **2**, **29**) that runs in many directions (not in edges only).

[0008] Philippine Patent Number 24939, issued on Dec. 26, 1990 with the Title: Shelter Components and Stocking Process for Multi-Storey Building; Inventor: Cesar V. Canchela of Quezon City, Metro Manila, Philippines, claimed in Item #1, "for a unitary prefabricated reinforced concrete rectangular-like shape body with opened longitudinal ends", "body having a planar bottom wall", "a pair of opposed planar sidewalls", "a pair of spaced apart outwardly extending post members", "a pair oppositely disposed support members" and "a planar top wall". FIGS. 1 and 2 of the said prior art also describes the claim.

[0009] A waffle slab tank for example as stated below dealt with tanks. http://patentscope.wipo.int/search/en/detail.jsf?docId=WO2005056936&recNum=1&maxRec=1&office=&prevFilter=&sortOption=&queryString=FP%3A%28waffle+box+concrete%29&tab=PCTDescription International application number PCT/AU2004/001728, inventor Stephen Cordell, title Slab Tank.

[0010] Another prior art, Philippine Patent Number 12302, issued on Jan. 16, 1979, with the Title: Pre-cast Reinforced Concrete Frame for a Multi-story Building Construction System, whose inventor Gregorio C. Concepcion of Quezon City, Metro Manila, Philippines, claims as follows:

[0011] "A concrete wall structure for use in multi storey building construction system, comprising of a set of lower frames anchored to the ground foundation such that the upper horizontal ribs of said lower frames are horizontally aligned with each other, . . . and a set of upper frames rigidly secured on top of said set of lower frames and consisting of spaced-apart frames such that the vertical ribs of the upper frames are vertically aligned with their corresponding vertical ribs of the lower frames . . . "

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The figures below will describe and illustrate the waffle box **27** technology. The figures although numbered in progression are grouped in two types. Type I describes about the five (5) side waffle box **27** (FIGS. **1** to **26**), while Type II describes about the four (4) or six 6) side waffle boxes **27** with wings **10** (FIGS. **27** to **56**).

[0013] The Type I five (5) side waffle box **27** is ideal for houses, shelter or building with different sizes of rooms. The Type I waffle box **27** with one bottom side open are installed on top of the other from foundation **26**, **26***a* or base level to the topmost deck **31**. The shelter or building can use different sizes of Type I waffle boxes **27**. The general rule however, in using Type I waffle box **27**, is to use same size waffle boxes and install them vertically in linear progression from foundation or base level to the topmost deck of the shelter or building. Then a different size of Type I waffle box **27** (but height must be the same) may be used in other parts of the same building, but the installation must be similar which is vertically in linear progression from foundation or base level to the topmost deck of the same shelter or building. The adjacent waffle slabs **2** are designed and fabricated to fit to the peripheral spaces around the Type I waffle boxes **27**.

[0014] The Type II four (4) or six (6) side waffle box **27** with wings **10** use the same waffle boxes (uniform in width, length and height) from foundation **26**, **26***a* (FIGS. **21**, **37**) or base level to topmost deck **31** (FIGS. **21**, **37**), regardless of its position in the shelter or building. The waffle boxes **27** (FIGS. **21**, **37**) are placed horizontally with an extra space **24** in between them. These extra spaces **24** or units are created using the walls **1** of these two adjacent waffle boxes **27**. The distance between the center lines of the thin walls **3** plus the rib **5** of the waffle box **27** and that of the extra

[0015] Space **24** are equal, so that when another waffle box **27** is laid on top of them (above the extra space **24**, the corbel **7** will be able to receive and fit the succeeding waffle box **27**. The process is repeated until the shelter or building is completed. The general guideline is that all centerline of the thin walls **3** plus the rib **5** of all the waffle boxes **27** at any level of the shelter or building are vertically aligned from the base level or foundation **26**, **26***a* up to the topmost deck (FIGS. **21**, **37**)

[0016] End waffle wall **30**, combined waffle wall and slab **29** and waffle slab **2** are placed at exterior end or deck to complete the box system. (FIG. **36**) illustrates these components.

[0017] Type II four (4) or six (6) side waffle box **27** with wings **10** have walls **1** in front and rear with punch opening for doors **12** and windows **12***b*, **12***c* or stairs, elevator shaft, etc. **12***d*. Type II six (6) side waffle box **27** is ideal for mass production especially for large projects or buildings. With front and rear walls **1** open, of the Type II waffle box **27**, the removal of forms is faster. The reduction of walls **1** as a result of the front and rear opening **12**, **12***b* will be addressed by rearranging the waffle boxes' **27** position (architect's' design) or in extreme cases introducing cast-in-place walls or other structural elements (structural engineer's design) at strategic areas in the shelter of building to maintain the structural integrity of the building. Punch opening or block out on walls **1** or slabs **2** intended for these cast-in-place structural elements can be integrated during casting of waffle boxes **27**. Once poured, on site or enhanced, sewed or stitched, they become an integral part of the structure. These processes are called "enhancing" or "stitching" or "sewing" and discussed on page **10**.

[0018] There are instances where waffle boxes **27** have punched openings **12**, **12***a*, **12***b*, **12***c*, **12***d* (FIG. **29***b*, **30**, **33**) to meet a desired need (window, door, stair, shaft, view area like atrium, or scenic elevator etc.) on almost all sides of the waffle boxes **27**. These conditions are allowed provided that the general rule is that those critical horizontal and vertical ribs **5** including the corbel **7**, **8**, **9** are left intact and must seek clearance from the structural engineer.

[0019] Type I Five (5) Sides Waffle Box **27**; (FIGS. **1** to **26**)

[0020] FIG. **1** is a plan of the five (5) sides waffle slab **2** with some basic features.

[0021] FIGS. **2** and **2***a* is a plan showing the bottom open side and the waffle wall **1** and its components like the wall **3**, ribs **5**, door and window opening **12**. The ribs **5** are trapezoidal in shape for easy removal of forms.

[0022] FIG. **3** is a sectional elevation showing ribs **5**, window opening **5***b*, corbel **7** and inverted corbel **8**. Also shown near the corbel **7** is a vertical and horizontal target **22** that will help plumb or align the building during the installation process. Below also shows the match groove **23** that will help align the lower and upper waffle boxes **27** during the installation process.

[0023] FIG. **4** is cross section showing waffle wall **1** and slab **2**, ribs **5**, window opening **12***b*, corbel **7** and inverted corbel **8**. Also shown on the corbel **7** are sockets for dowels **14**. Shown on the inverted corbel **8** below are holes **15***e* also for dowels **14**.

[0024] FIG. **5** is cross section showing waffle wall land slab **2**, window and door opening **12**, corbel **7** and inverted corbel **8**. Sockets for corbel **14** and holes for the inverted corbel **15***e* and lifting **15***d* are also shown.

[0025] FIG. **6** is a sectional elevation showing ribs **5**, window and door opening **12**, corbel **7**, inverted corbel **8** and vertical/horizontal target **22**.

[0026] FIG. **7** is sectional elevation showing ribs **5**, waffle wall **1**, door opening **12**, inverted corbel **8** and holes for lifting **15***d*. Also shown are dotted lines showing holes for dowels or pins **15**, vertical and horizontal target **22** and match groove **23**.

[0027] FIG. **7***a* is similar to FIG. **7** but features the diagonal ribs **5**.

[0028] FIG. **8** is a longitudinal section showing waffle wall **1** and slab **2**, corbel **7**, door and window opening **12**, holes for lifting and dowels or pins **15**. Also shown on the upper left is the wall and slab connection and also on right is the corbel **7** and waffle slab **2** connections.

[0029] FIG. **9** is a waffle box **27** to waffle box **27** and waffle slab **2** connections. The Type I five (5) side box is placed on top of each other. After alignment of the waffle boxes **27**, the dowels or pins **17** are fixed and grouted. The waffle slab **2** is placed next. In the Type I five (5) side waffle box **27**, these waffle slabs **2** around the waffle boxes **27** differ in length and width but not in height. These waffle slabs **2** are fabricated and installed individually.

[0030] FIG. **10** is a waffle box **27** and deck slab **2** connections. Also shown are the sealant **21**, hole **15**, dowel, or pin **17** and socket **14**.

[0031] FIG. **11** is a bolt connection **18***a* which is an alternative waffle box **27** to waffle box **27** connection. This type of connection can be also used as a temporary connection because the bolts **18** can be loosened and removed.

[0032] FIG. **12** is a welding plate **16** and/or dowel or pin **17** connections. The plates **16** are welded to fix the slab **2** to the corbel **7**. The socket **14**, hole **15**, dowel or pin **17** is a separate type of connection that can be used as an alternative to fix the waffle slab **2** to the corbel **7**.

[0033] FIG. **13** is a waffle box **27** to corridor **6** waffle slab **2** connections. Shown also are the socket **14**, hole **15** and dowel or pin **17** connections.

[0034] FIG. **14** is waffle slab **2** to waffle slab **2** connections. This connection is used when two (2) waffle slabs **2** meet. Sealant **21** is shown in this figure.

[0035] FIG. **15** is waffle box **27** front wall connection. Shown are welding plate **16** and angle **16***a* connection. Socket, hole, dowel or pin connection can be used also.

[0036] FIG. **16** is end waffle wall **30** connection. This connection applies when no adjacent slab is needed.

[0037] FIG. **17** is cast-in-place slab-on-fill and/or foundation **26** to waffle box **27** connection

[0038] FIG. **18** is an alternative lifting mechanism using a threaded cylinder with matching bolt with hook **13***a*.

[0039] FIG. **19** is another lifting mechanism using rod with matching hook and eye **13**.

[0040] FIG. **20** shows how the Type I five (5) side waffle boxes **27** are placed or installed on top of another. Also shown is the adjacent waffle slab **2**. The waffle boxes **27** are uniform while the waffle slab'**2** width and length may vary. The uniform waffle boxes **27** with their corbel **7** and connections support these waffle slabs **2** around them. This type of waffle box **27** is ideal for residential or multi-storey buildings with different room sizes. The general rule here is to make one or a couple of boxes uniform from foundation or base level to the topmost deck of the building so they can be installed or placed on top of one another. The waffle slabs **2** around the Type I waffle boxes **27** will follow. **25**

[0041] FIG. **21** is a cross section of a completed horizontal and vertical installation of the Type I five (5) side waffle boxes **27** and waffle slabs **2**.

[0042] FIG. **22** is a floor plan showing the side door opening **12***a* that allows the user to expand sideward equivalent to two rooms or waffle boxes **27**.

[0043] FIG. **23** is a floor plan showing the side door opening **12***a* that allows the user to expand sideward equivalent to one room or waffle box **27**.

[0044] FIG. **24** is a floor plan showing the side door opening that allows the user to expand sideward equivalent to one half room or waffle box **27**.

[0045] FIG. **25** is an isometric of Type I **5** sides waffle box **27** with window and door opening **12**.

[0046] FIG. **25***a* is an isometric of Type I waffle box with window and door opening **12**. This kind of waffle box **27** normally is installed on the deck. The bottom slab **2** is open for stair well, pipe chase, elevator shaft or the like.

[0047] FIG. **26** shows the progressive placement or installation of Type I **5** side prefabricated waffle boxes **27** and waffle slabs **2** around it.

[0048] B. Type II Four (4) or Six (6) Sides Waffle Box with wings **10**, FIGS. **27** to **56**

[0049] FIG. **27** is an isometric of Type II **4** or **6** side waffle box **27** with wings **10** (front, rear walls, and corridors),

[0050] FIG. **27***a* is an isometric of a Type II **4** or **6** side waffle box **27** with wings (front and rear walls, and corridor) **10** showing progressive installation.

[0051] FIG. **27***b* is an isometric of the installation process of Type II **4** or **6** side waffle box **27** with wings (front and rear walls, and corridor) **10**. The installation of the waffle boxes **27** at any same level is one extra space **24** apart. The installation of the second row of waffle boxes **27** for a double loaded designed building is also shown. The new waffle box **27** will rest above the extra space **24** created by the 2 lower waffle boxes **27**.

[0052] FIG. **27***c* is an isometric of the installation process of Type II **4** or **6** side waffle box **27** with wings (front and rear walls, and corridor) **10**. Also shown is the combined waffle wall with slab **30**, waffle slab **2**, and waffle wall **1**. These four (4) structural elements comprise the structural box system of the shelter or building. The waffle slabs **2** are punched or left open if you need it as stair, air well, elevator shaft or the like.

[0053] FIG. **27***d* is an isometric of the waffle slabs **2**, waffle walls **1**.

[0054] FIG. **27***e* is an isometric of the Type II **4** or **6** side waffle box **27** with corridor wings **10**.

[0055] FIG. **27***f* is an isometric of the Type II **4** or **6** side waffle box **27** with corridor wings **10**, with punch opening for stair well **12***d*. Punch opening **12***d* for waffle slab **2** can be wider or 100 percent open depending on the use, provided the perimeter frames, ribs **5**, corbel **7**, inverted or "z" corbel **8**, **9** are left intact.

[0056] FIG. **28** is a plan of the Type II four (4) or six (6) sides waffle box **27** showing top waffle slab **2** including corridor **10***a* and some basic features.

[0057] FIG. **29** is a plan showing the bottom waffle slab **2** and the waffle wall **1** and its components like the wall **1**, ribs **5**, door and window opening **12**.

[0058] FIG. **29***a* is a plan showing the Type II **4** or **6** side waffle box **27**' bottom waffle slab **2** and the waffle wall **1** and its components like the wall **1**, ribs **5**, door and window opening **12** and corridor wing **10***a*.

[0059] FIG. **29**B is a plan showing Type II **4** or **6** side waffle box **27** opening for stairwell **12***d*. Openings for slabs **2** are variable as needed, provided the horizontal and vertical ribs **5** including corbel **7** and "z" and inverted corbel **8**, **9** around are left intact.

[0060] FIG. **30** is a sectional elevation showing the wings **10**, ribs **5**, window opening **12**, and corbel **7**. Also is a vertical and horizontal target **22** that will help plumb or align the building during the placement or installation process. Below also shows the match groove **23** that will help align the lower and upper waffle boxes **27** during the placement or installation process.

[0061] FIG. **31** is cross section showing waffle wall **1**, wings **10** and slab **2**, ribs **5**, window opening **12**, corbel **7** and "z" corbel **9**. Also shown are sockets **14** and holes **15** for dowels or pins **17** and holes for lifting rod **15***d*.

[0062] FIG. **32** is cross section showing waffle wall **1**, wings **10** and slab **2**, window and door opening **12**, corbel **7** and "z" corbel **9**. Sockets for corbel **15** and holes for the "z" corbel **9** and lifting **15***d* are also shown.

[0063] FIG. **33** is a sectional elevation showing wings **10**, ribs **5**, windows and door opening **12**, corbel **7** and "z" corbel **9**. Vertical and horizontal target **22** and match groove **23** are also shown.

[0064] FIG. **34** is sectional elevation showing corridor **10***a*, ribs **5**, waffle wall **1**, door opening **12***a*, "z" corbel **9** and holes for lifting **15***d*. Also shown are dotted lines showing holes for dowels or pins **15**, vertical and horizontal target **22** and match groove **23**.

[0065] FIG. **35** is a longitudinal section showing corridor **10***a*, waffle wall **1** and slab **2**, corbel **7**, door and windows opening **12**, holes for lifting **15***d* and dowels or pins **17**. Also shown is the corridor rib **5**.

[0066] FIG. **36** shows the placement or installation process of the Type II six (6) side waffle boxes **27**. The waffle boxes **27** have one size only. First, they are laid horizontally with extra space **24** between waffle boxes **27**. The waffle walls **1** of the waffle boxes become the wall of the extra space **24**. The distance between the center lines of the thin wall **3** of the waffle box **27** and the extra space **24** are equal. On the next upper level, the Type II four (4) or six (6) side boxes **27** are placed on top of the extra spaces **24**. The "z" corbel **9** of the waffle box **27** being installed on the upper level will rest on the corbel **7** of the two waffle boxes **27** which are already installed below. Once installed, the waffle slab **2** becomes the ceiling of the extra space **24**. The installation process is repeated until the shelter or building is completed. The general rule is that the thin walls **3** from the foundation or base level up to the topmost deck are aligned. The number of waffle boxes **27** installed will create rooms or usable spaces equivalent to twice as much as their number.

[0067] Shown in the figure are end waffle wall **30**, combined waffle wall and slab **29** and waffle slab **2** that are placed on exterior end or deck to complete the waffle box **27** system.

[0068] The foundation **26** or slab is also designed to fit to the "z" corbel **9** of the waffle boxes **27**.

[0069] FIG. **37** is a cross section of a completed horizontal and vertical placement or installation of the Type II four (4) or six (6) side waffle boxes **27** including end waffle wall **30**, combined waffle wall and slab **29** and waffle slab **2**.

[0070] The figure shows that the number of usable spaces or units created by this technology is twice the number of waffle boxes' **27** fabricated and installed. The technology cuts the labor cost and construction time by a substantial figure by almost half.

[0071] FIG. **38** is a waffle box **27** to waffle box **27** connection. The six (6) side waffle box **27** is placed on top of the extra space **24**, thereby having the "z" corbel **9** rests on the corbel **7** of the waffle boxes **27** previously installed below. The figure shows the socket **14**, hole **15** and dowel or pin **17** connections.

[0072] FIG. **39** is a bolt connection **18***a* which is an alternative waffle box **27** to waffle box **27** connection. This type of

connection can be also used as a temporary connection because the bolts can be loosened and removed.

[0073] FIG. **40** shows welding plate and welding angle **16** connection.

[0074] FIG. **41** shows the front wall **3** connection using welding plate/anchorage and welding angle/anchorage **16**.

[0075] FIG. **42** is waffle slab **2** to waffle slab **2** connections. This connection is used when two (2) waffle slabs **2** meet, in this case, at the corridor.

[0076] FIG. **43** shows welding plates and welding angle **16** connection, Shown are waffle deck slab **31** and corbel **7** connections.

[0077] FIG. **44** shows welding plates and welding angle **16** connection, Shown is end waffle wall **30** and corbel **7** connections.

[0078] FIG. **45** shows cast-in-place slab and foundation **26** and prefabricated waffle box

[0079] FIG. **46** is an alternative lifting mechanism using a bolt **13***b*.

[0080] FIG. **47** is a ground floor plan for single detached house showing aligned waffle boxes **27** with an extra space **24** created at ground level and forwarded waffle box **27** at the second level. The garage, porch, living, dining, kitchen, stair well, or toilet and bath were created at the ground level.

[0081] FIG. **48** is a second floor plan for single detached house showing aligned waffle boxes **27** with extra space **24** at ground level and forwarded waffle box **27** at the second level. The bedrooms, stair well, family area, balconies, toilet and bath were created at the second level.

[0082] FIG. **49** is an attic plan for single detached house showing aligned waffle boxes **27** with extra space **24** at ground level and forwarded waffle box **27** at the second level and an attic with roof at the third level. The attic was created by utilizing the upper slab **2** of the waffle box **27**. Roof was used to cover the extra spaces **24** at the second level and attic at third level.

[0083] FIG. **50** is a cross section showing the 3 waffle boxes **27** and the 3 extra spaces **24** plus the attic that were created. All the needed spaces like living, dining, kitchen, garage, stair, toilet and bath, balconies, family room, etc. of a typical house were provided for.

[0084] FIG. **51** is a ground floor plan for single detached house showing 2 aligned waffle boxes **27** with 3 extra spaces **24** (1 at ground and 2 at second level). The garage, living, dining, kitchen, stair well, or toilet and bath were created at the ground level.

[0085] FIG. **52** is second floor plan for single detached house showing 2 aligned waffle boxes **27** with 2 extra spaces **24** or bedrooms at the second floor level. A roof was made to cover this second floor level. The arrangement of the waffle boxes **27** are versatile and will depend on the ideas of the architect or user of the technology.

[0086] FIG. **53** is a cross section showing the 2 waffle boxes **27** and the 3 extra spaces **24** that were created. A roof covering is shown.

[0087] FIG. **54** is a ground floor plan for single detached house showing a single waffle box **27** with 2 extra spaces **24** created at ground level and one extra space **24** at the second level. The garage, living, dining, kitchen, stair well, or toilet and bath were created at the ground level.

[0088] FIG. **55** is a second floor plan for single detached house showing a single waffle box **27** with one extra space **24** at the second level. A bedroom and a stair well were created at the second level. **31**

[0089] FIG. **56** is a cross section showing a single waffle box **27** and the 3 extra spaces **24** (2 at ground and 1 at second level). All the basic elements of a house were provided for.

[0090] FIGS. **57** and **57***a* are waffle box building technology code.

[0091] FIGS. **60** and **61** are plans showing waffle box **27** that are designed for "sewing" or "stitching"

[0092] FIGS. **62** and **63** are sections showing waffle box **27** that are designed for "sewing" or "stitching"

[0093] FIGS. **64** and **65** are elevations showing waffle box **27** that are designed for "sewing" or "stitching"

[0094] FIG. **66** is an isometric emphasizing micro portal frames **35**

[0095] FIG. **67** is an isometric showing the stilt foundation **26***a*

[0096] FIG. **68** is an isometric showing the opening **36** earmarked for cast-in-place stiffeners of which the process is called "enhancing"

[0097] FIG. **69** is an isometric of progressive installation of waffle box **27** with wings **10**, this time the waffles are inside

[0098] FIG. **70** shows waffle window sill or parapet

[0099] FIG. **71** shows waffle wall showing interior waffles

[0100] FIG. **72** shows waffle slab **2**

[0101] FIG. **73** shows combined waffle wall and slab **29**

[0102] FIG. **74** shows waffle slab **2** resting on foundation **26**

[0103] FIG. **75** is an isometric showing progressive installation of waffle slab and waffle box **27** with wings **10**, this time waffles are inside

[0104] FIGS. **76** and **77** are plans showing waffle box **27** with wing **10** that are purely ribs

[0105] FIGS. **78** and **79** are elevations showing waffle box **27** with wing **10** that are purely ribs **5**

[0106] FIGS. **80** and **81** are elevations showing waffle box **27** with wing **10** that are purely ribs **5** with provisions for "stitching" or "sewing"

[0107] FIG. **82** is an isometric showing waffle box **27** with wing **10** that are purely ribs **5** with provisions for "stitching" or "sewing" while resting on stilt foundations **26***a*

[0108] FIG. **83** is an isometric emphasizing micro portal frames **35** for waffle box **27** with wing **10** that are purely ribs **5** with provisions for "stitching" or "sewing"

[0109] FIG. **84** is a plan of waffle box **27** that are purely ribs **5** showing opening for stairwell, elevator shaft **12***d* or the like

[0110] FIG. **85** is a plan showing waffle box **27** with provisions for "stitching" or "sewing"

[0111] FIGS. **86** and **87** are elevations of waffle box **27** showing ducts for "stitching" or "sewing"

[0112] FIG. **88** is an isometric showing installation of precast stair **40**, **41**, **42**

[0113] FIG. **89** is a perspective showing of waffle box **27** with opening for stair **12***d*

[0114] FIG. **90** is an elevation of waffle fence **38**

[0115] FIG. **91** is a section of waffle fence **38**

[0116] FIG. **92** is an isometric of waffle fence **38**

[0117] FIG. **93** is a model house perspective of a 2-storey waffle box **27** house on stilt foundation **26***a*.

DETAILED DESCRIPTION OF SOME OF THE EMBODIMENTS

[0118] The Waffle Box Building Technology is an alternative prefabricated or cast-in-place building system that aims to solve the following pressing problems of any country:

[0119] a. The destructive effects of climate change like frequent flooding, strong typhoons, extreme tempera-

tures; freezing in the northern and southern hemisphere and heat in tropical, middle east and African countries;

[0120] b. Natural and man-made calamities like strong earthquake, hurricane, tornado, sand storm, snow storm, tidal wave, flooding, fire or even war;

[0121] c. Destruction of natural resources like cutting of trees, quarrying and mining as a result of construction boom and economic progress;

[0122] d. Long construction periods, unpredictable quality, wastage of materials and man-hours due to use of the traditional post/slab/beam system which are poured on site including the repetitive hauling of materials and manpower up and down the building sites;

[0123] e. Backlog in affordable housing, schools and offices as a result of fast growing population, rapid urbanization and migration due to improving economies;

[0124] f. Seemingly higher construction cost due to inflation, scarce and expensive land in urban centers as a result of booming economies; and

[0125] g. Lack of skilled workers because of higher pay in overseas jobs and migration to host countries that need their skills.

[0126] For problem a) and b); waffle box **27** is designed with stilt foundation **26***a*, concrete roof deck **31** and micro portal frames **35**. These properties mitigate the destructive effects of climate change, man-made and natural disasters like flood, fire, typhoon, earthquake, storm surge, tidal wave, hurricane, tornado, snow, and sand storm among others.

[0127] Waffles **3**, **4** can receive insulation **37** that results in lower electric bills both for cold and temperate countries. Insulation works against heat, freezing temperature and noise. Thinner walls **3** have less thermal mass, hence quicker to cool.

[0128] Waffle box is also green and sustainable. It is resilient, expandable and transferable. It uses less cement and steel which means less pollution and carbon footprint to produce them.

[0129] For problem c); waffle box **27** has thinner walls **3** and slabs **4** hence lighter (waffle **1**.**2**) with lesser cement and steel. Reduced usage of raw materials like gravel (raw material for concrete), lime (raw material for cement) and iron or manganese (raw materials for steel) means lesser destruction of our mountains.

[0130] Waffle box is an industrial building system that does not use wood for fabrication and installation.

[0131] For problem d); waffle box **27** is mass-produced in factories under controlled working condition. The standard steel form produces quality and uniform boxes. It is pre-finished and plug-in units. Most of the works are done at ground level. It is fast and hedges against fast rising cost of construction and controls project cost overruns.

[0132] The repetitive hauling up and down of materials and workers in project sites (especially for high-rise buildings) is eliminated.

[0133] For problem e) and f); waffle box **27** has thinner and lighter wall **3** and slab **4** but equally stronger and highly resistant to earthquake and other building loads. It uses less cement and steel hence cheaper. It is mass produced and fast. It is best for double loaded designed building (common hallway and stair), that reduces cost while increase building occupancies.

[0134] For problem g); waffle box **27** is an industrial building system. It utilizes more machines and less manpower. Being repetitive, the learning curve is shorter.

[0135] The name of the invention "waffle box" **27** came from these succeeding terms and meaning.

[0136] Waffle (noun) also as defined by Encarta dictionary is "a pattern of indentations on both sides", or "as in waffle iron for pancakes".

[0137] Box (noun) as defined by Encarta dictionary is "something that is square or rectangular in shape", "a container for objects or dry goods . . . ", "an enclosed area . . . ", "a small building that is used as a shelter", and "a compartment . . . ".

[0138] Wings (noun) also as defined by Encarta dictionary are "flat surfaces sticking out from the sides . . . "

[0139] In its technical terms, the Diaphragms and Shear Walls, Design/Construction Guide, by APA (The Engineered Wood Association, www.apawood.org), quoted herein, "A diaphragm is a flat structural unit acting like a deep, thin beam.", "A shear wall, however, is a vertical cantilevered diaphragm. A diaphragm structure results when a series of such vertical and horizontal diaphragms are properly tied together to form a structural unit. When diaphragms and shear walls are used in the lateral design of a building, the structural system is termed as "box system".

[0140] This invention is about prefabricated or cast-in-place structural "waffle box" **27** made of concrete or other materials; a square or rectangular in shape, an enclosed area used as a shelter or room, with or without wings **10**, **10***a*, **10***b*, with punched openings for windows **12***b*, **12***c*, doors **12**, **12***a* and stairs or elevator shafts, etc. **12***d* that will form part of a shelter or building or any other similar structure for a specific use.

[0141] In addition, this invention is a prefabricated or cast-in-place structural "waffle" **1**, **2** (a diaphragm of thin wall **3** or slab **4** with a pattern of orthogonal indentations on one of the faces called ribs) **5**, **5***a*, **5***b*, **5***c*, **5***d* "box" **27** (a series of horizontal and vertical diaphragms and shear walls tied together or poured monolithically to resist vertical, horizontal, torsion and other building loads) building technology it is lighter and cheaper but equally resistant to earthquakes, typhoons, hurricanes, and other building loads, etc. compared to a planar walls or slabs.

[0142] The waffle box **27** will either have five (5) sides (Type 1) (FIGS. **1**, **2**, **3**, **4**, **25**, **26**) or four (4) or six (6) sides (Type II) (FIGS. **27**, **27***a*, **28**, **29**, **29***a*, **29***b*) as the case maybe. All the sides of the waffle box **27** are designed to carry structural (vertical, horizontal, torsion, etc.) loads of a building. The waffle box **27** is either square or rectangular in shape.

[0143] The ribs **5**, **5***a*, **5***b*, **5***c* (sometimes called flange or chord) are rectangular or trapezoidal in shape for easy removal of forms (FIGS. **2**, **2***a*, **29**, **29***b*). The patterns of the ribs **5** to **5***d* are vertical, horizontal, diagonal, longitudinal or transverse.

[0144] The sizes and spacing of the ribs **5**, **5***a*, **5***b*, **5***c*, and its reinforcement are dictated by the number of floors, use of the structure, sizes of rooms, zoning and other design factors of the shelter or building and is the product of the structural design. A strictly rib (no crisscrossing member) design is strong for loads in one direction while the waffle **1**, **2** (vertical, horizontal, diagonal, longitudinal or transverse members) (FIGS. **7**, **7***a*, **34**) design is strong for loads in both directions. In the same mentioned APA design guide, it stated further that, "A diaphragm acts in a manner analogous to a deep beam

or girder, where the panels act as a "web," resisting shear, while the diaphragm edge members perform the function of "flanges," resisting bending stresses."

[0145] The ribs **5**, **5***a*, **5***b*, **5***c* are sometimes redesigned to serve a unique or special purpose. A corbel **7**, **7***a*, **7***b*, **7***c*, (FIGS. **3**, **4**, **5**, **7**, **9**, **10**, **11**, **12**, **13**, **16**, **38**, **39**, **40**) for example is an improved rib that will hold and carry the upper waffle boxes **27**, slabs **2** or walls **1** as the case maybe.

[0146] The rib or corbel **7** to **7***d* has holes **15**, **15***a*, **15***b*, **15***c*, **5***d* for fixing, lifting, and joining. It also has sockets **14**, **14***a*, **14***b*, **14***c* (FIGS. **9**, **10**, **12**, **13**) also for fitting or fixing the dowels or pins **17**, **17***a* (FIGS. **9**, **10**, **12**, **13**, **16**, **38**, **39**, **42**), for hauling **14***b*, and for fork lifting **14***c*.

[0147] Some ribs or corbel **7** has welding plates **16** (FIGS. **10**, **12**, **40**, **43**, **44**) and welding angles **16***a* (FIGS. **40**, **43**, **44**) to attach one with the other in order to attain structural integrity of the shelter or building.

[0148] Still, some ribs or corbels **7**, **7***a*, **7***b*, **7***c* are also provided with lifting cylinders/bolts **13***a* (FIG. **18**), or lifting bolts **13***b* (FIG. **46**) for lifting purposes. They also have vertical and horizontal target **22** and match groove **23** for alignment, better quality control and speed in the installation process.

[0149] On the lower part of the waffle box **27**, the ribs are developed as "z" or inverted corbels **8**, **9** (FIGS. **3**, **4**, **5**, **6**, **17**, **31**, **32**, **45**) that will fit these corbels **7**, **7***a*, **7***b*, **7***c*. As a matching element of the corbel, **7***a*, **7***b*, **7***c*, (FIGS. **4**, **5**, **7**, **8**, **9**, **11**, **16**, **17**), the inverted and "z" corbel **8**, **9** has holes **15**, **15***a*, **15***b*, **15***c*, **15***d*, (FIGS. **5**, **7**, **9**, **11**, **16**, **17**, **38**, **39**) welding plates **16** (FIGS. **10**, **12**) to best prepare these waffle boxes **27** for an integrated structural box system of the shelter or building.

[0150] These matching connections like the socket **14**, **14***a*, **14***b*, **14***c*, dowel or pin **17**, **17***a*, welding plate **16**, welding angle **16***a*, bolt **18**, **18***a*, **18***b* and hole **15***b*, **15***c*, are then fixed (FIGS. **9**, **11**, **16**, **37**), grouted (FIGS. **9**, **38**), welded (FIG. **40**), tightened (FIGS. **11**, **39**), painted or sealed **21** (FIGS. **9**, **11**, **38**, **39**, **40**), etc. to avert misalignment and corrosion and to ensure the structural integrity of the shelter or building (FIGS. **21**, **37**).

[0151] Optional features that are called wings **10**, **10***a*, **10***b* (FIGS. **27**, **28**, **29**) or corridors **8** or slabs **4** with specific purpose are monolithically added on corners of the box. Once installed in accordance with the procedures as stated in the later part herein, the extra space **24** (FIGS. **21**, **27***a*, **36**, **37**) or other spaces around the waffle box **27** receives the needed wall covering, slab, corridor or balcony or even additional living spaces without the need of extra activities on site.

[0152] Punch openings for windows **12***b*, **12***c*, doors **12**, **12***a* and stairs or elevator shafts **12**, **12***a*, **12***b*, **12***c*, **12***d*, etc. are integrated in the production process that will form part of the waffle box **27** for a specific use.

[0153] The weight of the structural box that was designed as waffle **1**, **2** is lighter than those designed using the traditional flat walls and columns or slabs and beams or girders, because of the hollow sections between ribs **5**, **5***a*, **5***b*, **5***c* **9** (FIGS. **2**, **29**). The walls **3** or slabs **4** (sometimes called skin) that connect the ribs are generally thinner. Furthermore, the term waffle **1**, **2** (FIGS. **2**, **28**) completely describes this reduced mass.

[0154] A reduced mass or volume or weight requires thinner structural members, including foundation **26**, and lesser or smaller steel reinforcements or the like, hence, cheaper shelter or building.

[0155] Thinner walls **3** and slabs **4** are lighter and require lesser materials like aggregates, cement and steel. This in turn will help preserve the destruction of our mountains (source of gravel and raw materials for cement and steel). Lesser cement and steel means lesser use of fossil fuel to produce them, hence lesser pollution and less carbon footprint. Thinner walls mean lesser thermal mass hence lesser heat absorbed during the day and faster to cool at night. Waffles wall **1** and waffle slab **2** can receive insulation materials to insulate noise, cool down the house or buildings and reduce consumption of electricity.

[0156] Lesser materials mean cheaper construction cost which can lead to affordable houses, schools and offices. More affordable houses are solutions to informal settlers, fast growing population and urbanization. More schools mean better education.

[0157] Another prior art is worth mentioning as it is useful in understanding this invention.

[0158] The special technical features of a planar box which has a flat surface with end posts is different from the waffle box **27**; that has thin wall **3** and slab **4** with a pattern of indentations called ribs **5** to **5***d*.

[0159] The planar box has posts while the waffle box **27** has none. The planar box has flat walls while the waffle box **27** has a thin wall **3** with a pattern of vertical, horizontal or diagonal ribs **5**. The planar box is closed on the top and bottom slab, while the waffle box **27** can be both closed and open provided that the perimeter corbel **7**, **7***a*, **7***b*, **7***c*, **7***d* or inverted and "z" corbel **8**, **9** or other ribs are retained for structural integrity of the waffle box **27**. Waffle boxes **27** with open slabs **12***d* are used for stair well, air well, elevator shaft, pipes chase, atrium or the like, while the closed planar box is silent on this feature. The planar box is not the same as the waffle box **27** in form and in appearance.

[0160] Additional research was made in http://patentscope.wipo.int/search/en/search.jsf, of which none appeared to have the slightest similarity with this invention.

[0161] The waffle box **27** building technology is consistent in its goal to provide a lighter but equally stronger, highly resistant to typhoons, hurricanes and earthquake, cheaper, and fast construction method that will address the backlog in the affordable housing, public and private school, and other shelter or building projects of any country.

[0162] Waffle box **27** is also resilient, green, and sustainable. It aims to preserve the world's natural resources, lessen pollution, lessen use of fossil fuel, and reduce carbon footprint.

[0163] It can mitigate the destructive effects of man-made and natural disasters like flood, fire, typhoon, earthquake, storm surge, tidal wave, hurricane, tornado, snow, and sand storm etc.

[0164] It can insulate against noise and hot and cold temperatures.

[0165] It can improve efficiency and quality in the construction of buildings, hedge against inflation, maximize use of expensive lands, increase building occupancies, and address the backlog in the affordable housing, schools and offices.

[0166] Waffle box **27** is an alternative housing solution to the fast increasing population and urbanization of any country and will combat the destructive effects of the world's climate change.

[0167] The waffle box **27** will have punched openings for windows **12***b*, **12***c* and doors **12**, **12***a* on its vertical walls

(FIGS. **5**, **6**, **30**, **31**, **32**). One door opening **12***a* (closed during casting but can be opened later) (FIGS. **2**, **25**) more or less situated at the mid span of the longer vertical side wall is earmarked for sideward room expansion (FIGS. **22**, **23**, **24**). This expansion which is equivalent to a minimum one half (½) size of the waffle box **27** (FIG. **24**), one waffle box **27** (FIG. **23**) or to as many as two waffle boxes **27**, (FIG. **22**) allows the occupant, user, or buyer for more options to expand.

[0168] Some waffle boxes **27** (FIG. **270**, have punched opening for slabs **12***d* which are intended for the stairwell, air well, elevator shafts, pipe chases, atrium or the like. The opening can be resized accordingly provided that the perimeter corbel or notch or other ribs are retained to maintain the structural integrity of the waffle box **27**.

[0169] Still some waffle boxes **27** are fabricated with limited or even without walls in front and rear sides (FIG. **27***e*) to give designers options for bigger windows and doors. In addition to this design option, this kind of waffle boxes **27** are best suited for mass production as the feature of free ends paves the way for fast and easy removal of interior forms. This will also make the waffle box **27** lighter.

[0170] In some instances, positioning of the waffle boxes **27** may be done in perpendicular with the other waffle boxes **27** in order to maintain structural integrity in both lateral and vertical directions of the shelter or building. This kind of mixed positions will require some features of the waffle box **27** to be adaptable.

[0171] Still, in some cases whereby these waffle boxes **27** (without front and rear wall) (FIGS. **27***e*, **27***f*) lacks the needed lateral frame as a result of the removal of its front and rear wall, or whenever necessary, the structural engineer may integrate other structural elements like walls, beams, etc. of different materials in the system to come up with a structurally viable shelter or building. This process is called "enhancing".

[0172] Further from the last two (2) previous paragraphs, especially in the design of medium and high-rise buildings, and taking into account the complexity of these waffle boxes **27** with lesser walls **3** or those laid in perpendicular with each other, etc. the structural engineer may integrate post-tensioning **33**, pre-stressing, and other technology to keep the buildings structurally safe. The ribs **5** can be designed to accommodate the ducts intended for the process. This process will be called "sewing" or "stitching"

[0173] The wings **10**, **10***a*, **10***b* of the waffle box **27** are improvements of the prior arts that were enumerated in the International Search Report; 1. GB 2 056 524 A (Hanford Realty Pty Ltd) 18 Mar. 1981 (1981-03-18), 2. U.S. Pat. No. 3,495,367 A (Kobayashi Hideya) 17 Feb. 1970 (1970-02-17), 3. U.S. Pat. No. 3,976,741 A (Lowe James N et al) 24 Aug. 1976 (1976-08-24), 4. U.S. Pat. No. 3,643,390 A (Shelley Shelly W) 22 Feb. 1972 (1972-02-22), 5. GB 1 246 369 A (Wood Edgar Herbert [US]), 15 Sep. 1971 (1971-09-15), and the Philippine Patent Number 24939, issued on Dec. 26, 1990 with the Title: Shelter Components and Stocking Process for Multi-Storey Building; Inventor: Cesar V. Canchela of Quezon City, Metro Manila, Philippines.

[0174] Wings **10**, **10***a*, **10***b* are cast monolithically with the main box. These wings **10**, **10***a*, **10***b* serve as walls **10**, doors **10***a*, windows **10***b*, corridors **6**, or slabs **4** extending from the basic box (FIG. **28**, **29**, **30**, **31**, **27**, **27***a*, **27***b*), to perform vital functions for the building or structure. Being monolithic with the box, these works are eliminated on project sites. Hence, waffle box **27** with wings **10** aims to solve tedious, expensive, poor quality, long construction methods that are normally done on sites. Shorter construction time hedges against rising cost of construction materials.

[0175] Here follows the notable differences among the prior arts mentioned in the International Search Report and waffle box **27** with wings **10**, **10***a*, **10***b:*

[0176] 1. Hanford Realty Pty. Ltd. Is a three dimensional box, has waffle but has no wings. Waffle box **27** exhibits all the three features; a three dimensional box, has waffle **1**, **2**, and wings **10**.

[0177] 2. Kobayashi Hideya is not a three dimensional box, has waffle but has no wings. Waffle box **27** exhibits all the three features; a three dimensional box, has waffle **1**, **2**, and wings **10**.

[0178] 3. Lowe James N et al is also three dimensional box, has waffle, but has no wings. Waffle box **27** exhibits all the three features; a three dimensional box, has waffle **1**, **2**, and wings **10**.

[0179] 4. Shelly Shelly W is also a three dimensional box, has no waffle (planar wall) and has no wings. Waffle box **27** exhibits all the three features; a three dimensional box, has waffle **1**, **2**, and wings **10**.

[0180] 5. Wood Edgar Herbert is a three dimensional box, has no waffle (planar wall) and has wings. Waffle box **1**, **2** exhibits all the three features; a three dimensional box, has waffle, and wings.

[0181] Therefore, waffle box **27** with wings **10**, **10***a*, **10***b* is a box with a waffle and a wing that exhibits improved characteristics of the prior arts (FIGS. **27***a*, **27***b*,).

[0182] Waffle box **27** has a pattern of indentations on one of its faces. These indentations are called ribs **5**. These ribs **5** run along the perimeter walls **3** and slabs **4** and are aligned, parallel and quadrant with the other. There being many and uniformly spaced in a waffle box **27** and in the series of waffle boxes **27** connected to one another to form a building, these ribs **5** including the tee (FIG. **35**, **36**) section become the diaphragms and shear walls of the building. They also function as micro portal frames **35** (FIG. **36**, **37**).

[0183] All the building loads (horizontal, vertical, torsional, etc.) that act on the building or structure are divided and reduced in smaller magnitude equivalent by the number of portal frames **35** in the building (FIG. **36**, **37**). Micro portal frames **35** that resist smaller loads are efficient and economical as compared to conventional post and beam that are spaced far apart from each other. Thus, buildings designed with micro portal frames **35** are highly resistant to earthquake, hurricane, tornado, super typhoon, tidal wave, storm surge, sand storm, snow, etc. which are prevalent in any parts of the world.

[0184] Waffle box **27** can rest on stilt foundation **26***a* and has concrete roof deck slab **31** that mitigates the disastrous effects of flood, typhoon, storm surge, and tidal waves.

[0185] Waffle box **27** is an alternative housing solution that can combat the destructive effects of the world's climate change.

[0186] According to an article published in Sep. 6, 2014 http://business.inquirer.net/178173/helping-the-poor-own-their-homes, "Fifty-four percent of the world's population—about 3.8 billion—are now living in urban areas. And with almost 200,000 people being added to the world's cities every day, the United Nations estimates that by 2050 the world's urban population will stand at over 6.3 billion—nearly double of what it is today. According to global environmental

research organization Worldwatch Institute, such rapid urban population growth will be especially burdensome for developing countries where 82 percent of the world's population currently lives."

[0187] The population of the world is 7.046 billion as of year 2012 with annual growth rate of 1.1%, or 77.5 million people each year, based on https://www.google.com.ph/#q=population+growth+rate+in+the+world.

[0188] Some countries have higher annual growth rate (as of 2012), Singapore is 2.4%, Malaysia and Philippines is 1.7%, based on https://www.google.com.ph/#q=population+growth+rate+in+the+philippines. The time is ripe for new technological advancement in the construction industry especially in counties with fast increasing population and economy. The country with fast increasing population must supply the needed shelter for its people while the country with fast growing economy will prepare for more people who will look for greener pastures in their country. Urbanization becomes rapid.

[0189] Waffle box building technology is an industrial building system wherein waffle boxes **27** are produced in factories under controlled conditions. The production and construction is standardized, leading to fast and affordable houses and shelters. This is an alternative housing solution and will help address urbanization.

[0190] Described in the succeeding paragraphs are typical features of the waffle boxes **27** with five (5) sides Type I and four (4) or six (6) sides Type II.

[0191] Type I five (5) sides waffle box **27** and Type II four (4) or six (6) side waffle box **27** have different installation procedures. Type I was abandoned and Type II process is claimed by this invention.

[0192] Type I Waffle Box **27**, **5** sides, bottom slab open, installation is vertical on top of one another.

[0193] Type I waffle box **27** has five (5) sides. The bottom slab is left open. This opening is designed to fit to the upper slab of that same Type I waffle box **27**. They are installed vertically on top of the other (FIG. **20**).

[0194] Type I waffle boxes **27** (FIGS. **1**, **2**, **3**, **4**, **5**, **6** **7**) vary in width and length but not in height when positioned in any part of the shelter or building (FIG. **26**). Type I waffle boxes **27** are installed in linear progression from foundation **26** or base until the boxes reach the topmost deck (FIGS. **20**, **21**); hence, each column of boxes must have uniform width, length and height. The user of this invention might opt for Type I waffle boxes **27** with another width and length but not height in some other section of the shelter or building, but must follow the general rule of installing a uniform waffle box **27** from foundation **26** or base until it reaches the topmost deck (FIGS. **20**, **21**).

[0195] The practice of using different Type I waffle boxes **27** in a shelter or building gives the user flexibility in the design. It is however, suggested to use a uniform waffle box **27** in any section of the building in order to save for the cost of formworks and to benefit from operating on the economies of scale.

[0196] A series of pre-designed waffle slabs **2** or waffle walls **1** (FIG. **27***d*) must be installed around these Type I waffle boxes **27** in order to complete the structural box system of the shelter or building. Standard connection details like the dowels or pins **17** to **17***b*, bolts **18** to **18***b*, welding plate **16** and welding angle **16***a* are available for users to choose from.

[0197] B. Type II Waffle Box **27** with wings **10** four (4) or six (6), installation is horizontal with extra space **24** in between waffle boxes **27**

[0198] Type II waffle box **27** with wings **10** has four (4) or six (6) sides. They have uniform width, length and height in all parts of the shelter or building (FIGS. **36**, **37**).

[0199] The Type II waffle boxes **27** with wings **10** are laid horizontally with uniform space apart (FIG. **27***a*), thereby creating one extra space **24** or room or unit between them. The horizontal distance of the center of the thin walls **3** of the waffle box **27** and that of the extra space **24** are equal (FIG. **36**, **37**). As a general rule, the center line of the thin walls **3** plus the rib **5** from the foundation **26** (FIG. **45**) or base up to the topmost deck is aligned. Type II waffle boxes **27** have the same length, width and height (FIG. **27***b*).

[0200] On the next upper level, the installation of the Type II waffle boxes **27** must start directly above the leftmost or rightmost extra space **24** and progressively towards the other end (FIG. **27***a*). A waffle wall **1** and waffle wall and slab **29** are introduced at exterior end (FIG. **27***c*) as the case maybe to complete the floor or level of the shelter or building. The horizontal installation of the Type II waffle boxes **27** is repeated to the next upper level until the structural box system of the shelter or building is completed (FIG. **27***a*, **36**, **37**).

[0201] Using this horizontal installation process for Type II waffle boxes **27** with wings **10** means that when you install "x" number of waffle boxes **27**, the result is "2x" number of usable boxes or spaces (FIG. **36**, **37**) with end waffle wall **1** and combined waffle wall and slab **29**, (FIG. **36**) being introduced at some exterior end to complete the structural box system of the shelter or building. As a prefabricated construction system, plus this special method of horizontal installation, the construction period of a shelter or building is very much shorter as compared with a building done using the traditional way (post, beam, slab, wall system).

[0202] The cost of labor to construct another room or livable space (extra space **24** between waffle boxes **27** is eliminated and he construction time is shortened, hence cheaper. This will solve backlog in affordable housing and schools due to fast increasing population and urbanization.

[0203] Should the users of the invention opt to design a double loaded shelter or building (FIG. **27***a*) (two waffle boxes facing each other with common corridor), the horizontal installation of the line of waffle boxes **27** with wings **10** fronting the first row shall be alternate; the waffle box **27** facing the extra space **24** or the extra space **24** facing the waffle box **27** (FIG. **27***a*). The Type II waffle box **27** with wings **10**, (FIGS. **27**, **27***b*) with extending corridor **6** is best suited for this design.

[0204] According to www.globalpropertyguide.com/Asia/Philippines, land values have been appreciating recently. In the second quarter of 2013:

[0205] In Makati CBD, land values rose by 8.32% to PHP283,185 (US$6,462) and PHP325,275 (US$7,423) per sq. m. During the latest quarter, land prices increased by 2.06% in Q2 2013.

[0206] In Ortigas Center, land values increased by 6.45% to a range from PHP104,925 (US$2,394) to PHP171,860 (US$3,922) per sq. m. Quarter-on-quarter, land values rose by 1.75%.

[0207] In Bonifacio Global City, land values rose by 8.47% y-o-y and 1.8% q-o-q to a range from PHP200,850 (US$4,583) to PHP292,900 (US$6,684) per sq. m.

[0208] With these increasing rates of the land, it is economical to design and construct double loaded buildings (with common stairs and corridors). Waffle box **27** with wings **10** is best suited for this design. It does not only maximize the use of expensive land but as well as increase building occupancy. This is an alternative solution in the backlog of affordable housing and school buildings, fast rising population growth and urbanization in any country.

[0209] Users of the Type II waffle boxes **27** with wings **10** save on cost of formworks and enjoy the benefits from operating on the economies of scale.

[0210] Being mass produced at ground level, prefinished and plug-in units, waffle box **27** with wings **10** offers an alternative solution to the tedious, expensive, unpredictable quality, long construction periods of the traditional on site construction of post, beam and slab system and hedges against fast rising cost of construction and cost overruns.

[0211] Again, a prior art mentioned earlier uses a similar process of installation for a single loaded shelter or building, one (1) row as shown in (FIGS. **1**, **2**, **5**, **6** and **9**) of the said invention. The same prior art was useful in the understanding of this invention that gave way for a better or

[0212] improved horizontal installation process that is in accord with the invention's goal to address the backlog in the affordable housing, public schools, and other shelters or buildings in any country today thru an alternative building system that is lighter but equally stronger, high resistant to earthquake, typhoon or hurricane and subsequently cheaper and fast.

[0213] Philippine Patent Number 24939, issued on Dec. 26, 1990, with the Title: Shelter Components and Stocking Process for Multi-Storey Building; Inventor: Cesar V. Canchela of Quezon City, Metro Manila, Philippines, claims as follows:

[0214] Claim 5. "A stacking process for shelter components as recited in claim 4 wherein mounting one shelter component on top of the shoulder portions of the two shelter components includes a plurality of spaced apart downwardly projecting anchoring bolts oppositely disposed at the bottom portion of said one shelter component adapted to be snugly fitted to a corresponding plurality of spaced apart embedded metal tubes disposed on top of the planar sidewall of said two shelter components."

[0215] Claim 6. "A stacking process for the shelter components as recited in claim 4 wherein mounting one shelter component on top of the shoulder portions of the two shelter components further includes an upstanding angularly bent embedded steel bars having a fixedly secured metal plates disposed on opposite planar sidewalls of said one shelter component adapted to be weldably secured to the corresponding angular metal plates fixedly secured to an interconnected generally V-shaped steel bars embedded on the shoulder portions of said shelter components".

[0216] Both claims 5 and 6 are supported with FIGS. **3**, **4**, **5**, **6** and **7** of the said invention.

[0217] While there appears to be a similarity in the process of installation in both the planar box (prior art) and the waffle box **27** with wings **10** (this invention), both having space in between boxes and the next box above rests on both boxes below, and so on, there exists a seemingly obvious differences between the two arts which are summarized as follows:

[0218] 1. While the installation process is seemingly similar, the prior art is silent to address or describe in the specifications and also by way of figures how the stairs, elevator shafts, pipe chases, air wells, garbage chutes, or the like which are vital elements of a shelter or building, are incorporated during the upward installation of boxes. There is a need for an opening **12***d* in the slab or even wall to accommodate these basic features of a building or shelter. This invention attempts to provide a unique solution to that need.

[0219] This invention of Type II four (4) or six (6) side waffle boxes **27** with wings **10** with punch opening for stair, elevator shaft, etc. (FIG. **27***f*) that are laid similarly as the prior art, but will not need any introduction of cast-in-place walls or structure to accommodate those vital openings of the shelter or building. Stairs can be prefabricated and installed in the open stair wells without cast-in-place operations. Same with the others like elevators, etc. as the predesigned punched openings **12** are provided for.

[0220] This invention having included in the installation or stacking process the punched opening **12***d* for the stair, elevator, chases and the like which are vital elements of a shelter or building laid a predicate that the prior art and this invention are two different special technical features. Cast-in-place operations will affect the concept of mass production.

[0221] The introduction of the waffle **1**, **2** and wings **10** is an improvement of the prior arts and the installation of the second row of Type II waffle boxes **27** is totally different.

[0222] 2. While both prior art and this invention aim to address the backlog in the affordable or mass housing and other building project of any country by means of the stacking or installation process of the boxes (FIGS. **27***a*, **36**, **37**) of this invention), the prior art cited on the single loaded shelter or building (single row building) as explained in the specifications and shown in FIGS. **3**, **4**, **5**, **6** and **7** of the said prior art. The double loaded design as featured by this invention utilizes a common corridor or hallway for the livable units in the case of housing project or classrooms in the case of school projects, thereby maximizing the use of the lot.

[0223] This invention considers both single loaded and double loaded designed buildings. Beyond the installation or stacking process of the first row of waffle boxes **27**, there exists in this invention another unique product and process of installing the second row of waffle boxes **27** with wings **10** (FIG. **27***a*), specifically designed for a double loaded shelter or buildings. The waffle boxes **27** with wings **10** have corridors **6** which are extensions (or wings) of both the top and bottom slabs **4**, (FIG. **27***b*, **36**, **37**). The protruding length of the corridor **6** is half the width of the hallway. Using the first row of installed waffle boxes **27** with wings **10** (also with corridors **6**), the new waffle boxes **27** with wings **10** will be fitted alternately in front of the extra spaces **24** (FIGS. **27***a*, **27***b*, **36**) aligning the edges of both the corridors **6** of the first row and the second row of the Type II waffle boxes **27** with wings **10** (FIG. **27***a*). On the next upper level, the resulting structure will have the top corridor **6** of the first row of waffle boxes **27** with wings **10** meet with the bottom corridor **6** of the second row of waffle boxes **27** with wings **10** (FIG. **27***a*). The installation process is repeated alternately for the waffle box **27** in front of the extra space **24** and the extra

space **24** in front of the waffle box **27**, (FIGS. **27***a*, **36**). As the top and bottom corridors **6** of the waffle boxes **27** meet alternately, the hallway is completed FIG. **27***a*. The width of the hallway is the total length of the two meeting corridors **6** (FIG. **27***a*, **35**, **42**).

[0224] Like in the previous specifications of the Type II waffle boxes **27** with wings **10**, waffle wall **3** and combined waffle wall and slab **29** (FIG. **27***c*) are introduced at exterior end to complete the structural box system of the shelter or building.

[0225] In the above difference #2, the lot is maximized by designing a double loaded high density shelter or building using the invention, which is an improvement of the prior art. The cost is cheaper as the cost of common facilities like the hallways, stairs, or elevators is distributed between the fronting units.

[0226] 3. Another unique feature of this invention is Type I waffle box **27** (5 sides) which is installed vertically on top of one another (FIGS. **20**, **21**). This installation process of Type I waffle box **27** is significantly different from the said stacking process of the said prior art.

[0227] All the waffle boxes **27** are precast and mass produced in fabrication sites without or in extreme cases a very minimal cast-in-place operation on site. All the waffle boxes **27** are uniform (except for the punched slab opening **12** thereby the user of the invention enjoys the benefit of producing by economies of scale.

[0228] While the above prior art describes a similar stacking process of a frame that also runs in parallel with the previous Philippine Patent Number #24939 that uses a planar box, there exist in this invention a unique product (waffle box **27**) with wings **10** and installation process (beyond the single-loaded building) that will differentiate this invention from what was earlier contributed by the mentioned prior arts.

[0229] Basing on the above installation process of a double loaded designed shelter or building, there is a totally different concept of installation by this invention. First, the double loading concept and the second is the alternate installation of the second row of waffle boxes **27** with wings **10** which was not touched by the prior art and third, the vertical installation process of Type I waffle boxes **27**.

[0230] Further to the Type II waffle box **27** with wings **10** with four (4) or six (6) sides, the waffle slab **2** will meet with the waffle wall **1** which will form a "z" corbel **9** (FIG. **38**, **39**, **44**, **45**) at the bottom (FIGS. **38**, **39**, **40**). These matching connections like the socket **14**, **14***a*, **14***b*, **14***c*, dowels or pins **17**, **17***a*, welding plates **16**, welding angles **16***a*, and holes **15***b*, **15***c*, as earlier described are then fixed (FIG. **37**, **39**, **40**), grouted (FIG. **38**, **39**), welded (FIG. **40**), tightened (FIG. **39**), painted or sealed **21** (FIG. **37**), etc. to avert misalignment and corrosion and to ensure the structural integrity of the shelter or building (FIG. **37**).

[0231] Buildings or shelters that are designed to have uniform room layout per floor (FIGS. **36**, **37**) (as in high rise buildings, dormitories, inns, mass housing, schools, etc) are easier, faster, and cheaper to construct using this invention.

[0232] The Type I waffle boxes **27** with five (5) sides (no bottom slab) are installed on top of one another (FIGS. **20**, **21**), while the Type II waffle boxes **27** with wings **10** with four (4) or six (6) sides are installed alternately on top of the two other waffle boxes **27** with wings **10** (FIGS. **36**, **37**). A waffle wall **1**, combined waffle wall and slab **29** and a waffle slab **2** are special waffle individual units (not fabricated as box) that will be integrated at exterior ends and deck (FIGS. **27***c*, **36**), as the case maybe, until the installation of the waffle box **27** shelter or building is completed (FIG. **37**).

[0233] The corridor of the Type I five (5) side is a precast slab **2** (FIG. **26**) or a cast-in-place slab whichever is economical and feasible.

[0234] The uppermost deck (FIG. **20**, **21**) of the building using the waffle boxes **27** with wings **10** will be given special attention to control leak in the future. A slope and a sealant **21**, (FIG. **42**) is a must for the roof deck to be leak-free (FIG. **37**).

[0235] The design of cast-in-place foundation **26** (FIGS. **17**, **45**) and the stilt foundation **26***a* are dictated by the nature of soil, height and size of the building, earthquake zoning and other design parameters. Stilt foundation **26***a* is best to mitigate flood, storm surge, tidal wave, etc.

[0236] In either type of waffle boxes **27** with wings **10**, the stair well, air well, elevator shaft, pipe chase, and the like (opening **12***d* is dictated by need) are left open (FIG. **27***f*) with attachments or provisions for their specific use. Stairs **40**, **41**, **42** can be prefabricated concrete or steel.

[0237] In either case, these waffle boxes **27** with wings **10** create additional spaces around, between, below and above them without spending more for the vertical support (FIGS. **20**, **21**, **36**, **37**). This invention, especially the Type II four (4) or six (6) sides waffle box **27** with wings **10**, creates almost double the number of usable spaces (FIGS. **36**, **37**) without the need for more extra activity and cost except in some end spaces (where a box can't fit) wherein a combined waffle wall and slab **29** ("L" shape slab) and waffle wall **1** is to be installed or constructed (FIG. **36**).

[0238] In the case of single detach residential houses, the Type II four (4) or six (6) sides waffle boxes **27** with wings **10** are laid one space apart, some aligned in front while others are moved forward or backward (FIGS. **47**, **48**, **49**, **50**, **51**, **52**, **53**, **54**, **55**, **56**) as the case maybe, in order for the designers to be creative in aesthetic designs and specific purpose like balcony, stair, attic, toilet and bath, etc. Roof is an option while users of the invention can utilize the concrete slab **31** as deck. Walls are specially fabricated.

[0239] It is the goal of this invention to simplify, reduce, or eliminate the redundancy, repetitive work, wastages, etc. brought about by the numerous construction activities done above ground including hauling up of materials, tools, equipment and movement of workers up and down (especially for high rise buildings), resulting to speed, efficiency, economy, and quality of the building. The waffle boxes **27** therefore, including its electrical, plumbing, cable, telephone, internet, alarm, background music pipes, etc., wiring and architectural and other finishes are done or can be done at the ground floor level or off-site fabrication sites, thereby transforming these waffle boxes **27** as a pre-assembled, pre-finished or plug-in, and ready to use units of a shelter or building.

[0240] Fabrication of the structural waffle boxes **27**; in sections or whole, is dictated by the hauling, lifting, stocking, and actual situations on site or off-sites. The mass production of the waffle boxes **27** is done in controlled fabrication sites.

[0241] Cast-in-place waffle boxes **27**, in extreme or special circumstances are done or can be done at job sites.

[0242] Lifting mechanisms are made of metal rods **13**, cylinder **13***a*, bolts **13***b* with matching hooks (FIGS. **18**, **19**), that are all embedded in the concrete (FIGS. **18**, **19**), or socket **14***b* at the base in the case of a fork lifting equipment Their frequency, sizes and anchorages are all subject to the results of the structural design.

[0243] Simple but strong connection inverted and "z' corbel **8**, **9**, holes **15**, dowels/pins **17**, bolts **18**, steel angles **16***a* or plates **16**, lifting hooks **13**, or cylinders **13***a*, etc. (FIGS. **11**, **12**, **14**) of different materials, sizes and shapes that encompasses the invention's goal of ease, practicability, efficiency, economy, stability and strength as shown or as presented in the drawings including the design, formworks, fabrication, lifting, hauling, placing, and fixing of the boxes to form a complete "waffle box **27**" building system are covered by this invention.

[0244] Most specifically, as a prefabricated, prefinished, plug-in or insulated structural waffle box **27**, this invention minimizes the repetitive hauling, lifting, transporting of materials, tools, manpower from the ground up to the building (especially for high rise building), thereby cutting construction costs, improving work efficiencies, and maintaining product quality under a controlled work place at the ground floor or factory sites.

[0245] With these savings, and improved quality and efficiency, waffle box **27** with wings **10** hedges against fast rising cost of construction, and diminishes the problem of cost overruns.

[0246] The space between the ribs **5** where the waffles are created can be used to hold heat and sound insulation **37** materials thereby upgrading this invention as an insulated concrete building technology.

[0247] Other than the purpose of creating a unique product and installation process claim for the invention, it is further aimed to develop a simple, durable, workable, economical, efficient, functional, light, fast and easy construction system that will solve the backlog in affordable housing, public and private schools, offices, hotels, dormitories, inns, apartments, etc, and in other small, medium or high rise building or shelter projects in any country. In the design and the actual implementation of this invention, some or several parts of the waffle boxes **27** and the technology as a whole will be modified to suit its adaptability to the present and future times.

[0248] Materials to be used for the present design and for the further development of the technology in order to maximize the benefits therein, can be any kind of concrete, steel, formed sheets, plastic, wood, laminates, synthetics or their combinations.

[0249] These stated improvements above become parts and partial of the invention.

[0250] For practical reasons in future site conditions, weight of waffle box **27** with wings **10**, magnitude of projects, budget limitations, etc. the technology can shift to a cast-in-place method of construction but still using the same process of building the waffle boxes **27** either directly above one another or alternately above the others.

[0251] Some waffle box **27** with wings **10** may have lesser indentations or is purely ribs **5** (FIG. **75**, **77**, **78**, **79**, **80**, **81**, **82**). The positions of the ribs **5** are arranged to resist all directional loads of the structure. This kind of waffle box **27** with wings **10** will still be analyzed as diaphragms and shear walls using the micro portal frame **35** (FIG. **66**, **83**) which can also be used for cast-in-place houses. Slab on fill or slab foundation **26** (FIG. **17**,**21**,**37**) can also be designed as waffles.

[0252] Covered by this invention are the following:

[0253] 1. For residential use whether one or two-storey, single detached, multi-dwelling, duplex, quadrant, row house, walk-up or multi-storey apartment, townhouse, dormitory, condominium, affordable or mass housing, or all kinds of shelters.

[0254] 2. For commercial use like office building, hotel, motel, inn, call center, mall, parking space, or all kinds of shelters of similar use.

[0255] 3. For institutional use like school building, learning center, day care center, hospital, clinic, government center, or all kinds of shelters of similar use.

[0256] 4. For any kind of box-like structures laid vertically, horizontally or diagonally like bridge, canal, caisson, well, tunnel, shaft, or the like that will fall within the basic principle of mass production, economics, speed, strength, etc.

What is claimed is:

1. A horizontal and vertical process of installation using two (2) or more type II waffle boxes facing each other with extending corridor or wall which is a wing, the line of waffle boxes fronting the first row is alternate; the waffle box facing the extra space or the extra space facing the waffle box, which is best suited for double loaded shelter or building.

2. A horizontal and vertical process of installation as recited in claim **1** wherein on the next upper level, the installation of the type II waffle boxes must start directly above the leftmost or rightmost extra space and progressively towards the opposite end, and is repeated until the structural box system of the building is completed.

3. A horizontal and vertical process of installation as recited in claim **1** wherein the type II waffle boxes is made of a thin wall and slab with a pattern of orthogonal indentations on one of its faces called ribs and is poured monolithically to form a waffle box.

4. A horizontal and vertical process of installation as recited in claim **1** wherein type II waffle boxes have punched openings for stair elevator shaft, or for any similar use.

5. A horizontal and vertical process of installation as recited in claim **1** wherein the centerlines of the thickness of the thin wall plus the rib of the waffle boxes from foundation to the uppermost deck are aligned.

6. A horizontal and vertical process of installation as recited in claim **1** wherein special elements such as the end waffle wall and waffle slab and the combined waffle wall and slab are introduced at the leftmost, topmost and rightmost part respectively, incorporating the features for joining, lifting, aligning, hauling that are shown in.

7. A horizontal and vertical process of installation as recited in claim **1** wherein some cast-in-place structural elements like wall, beam, and other structural elements, are introduced in the system to come up with a structurally enhanced shelter or building, which will be termed "enhancing".

8. A horizontal and vertical process of installation as recited in claim **1** wherein the following features like trapezoidal corbel and "z" corbel or inverted corbel are designed to support and stabilize the waffle boxes.

9. A horizontal and vertical process of installation as recited in claim **1** wherein the following features like sockets, holes, welding plate or welding angle with their matching pins, dowels, bolts, and sizes of welds are designed to join two or more waffle boxes.

10. A horizontal and vertical process of installation as recited in claim **1** wherein the following features like vertical/horizontal target and match groove are designed for quality control and fast installation.

11. A horizontal and vertical process of installation as recited in claim **1** wherein the following features like cylinder with bolt, rod with eye, bolt with fork or plate, socket for fork lift are designed for lifting and hauling of the waffle boxes.

12. A horizontal and vertical process of installation as recited in claim **1** wherein the waffle boxes are made of all kinds of lightweight or standard weight concrete (standard or blended), plastic, wood or its derivative like laminated wood, metal including steel sheet or its improved products like the pre-formed, bended, punched sections, aluminum, fiberglass, or glass.

13. A horizontal and vertical process of installation as recited in claim **1** wherein the waffle boxes can be prefabricated, prefinished, plug-in, or insulated.

14. A horizontal and vertical process of installation as recited in claim **1** wherein all sorts of false or formworks to cast, fabricate, mold and create and turn these waffle boxes and its components like waffle wall, waffle slab, combined waffle wall and slab, foundation, stairs, etc. into usable parts of the shelter, building or any type of box-like structure.

15. A horizontal and vertical process of installation as recited in claim **1** wherein some waffle boxes which are positioned in parallel or perpendicular with the other waffle boxes in order to maintain structural integrity in both lateral and vertical directions of the shelter or building, will introduce structural elements; example posttensioning, prestressing, etc., which will be termed "sewing" or "stitching".

16. A horizontal and vertical process of installation as recited in claim **1** wherein the waffle boxes are analyzed and designed using a series of micro portal frames (series of "tee", "cee" or "I" sections running along the perimeter of the waffle boxes) including those that are purely ribs to resist all kind of loads in different directions.

17. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings, which is made of a thin wall and slab with a pattern of orthogonal indentations called ribs on one of its faces and is poured monolithically to form a waffle box, which is an improvement of the prior arts, wherein these monolithic wings extends from the basic box, and function as walls, doors, windows, corridors, or slabs of the building.

18. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein the first level of waffle boxes are installed with extra space between them and the next upper layer of waffle boxes will sit direct above the extra spaces and with special members such as the end waffle wall and waffle slab and the combined waffle wall and slab are introduced at the leftmost, topmost and rightmost part respectively and is repeated until the structural box system of the building is completed.

19. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein type II waffle boxes have punched openings for stair, elevator shaft, or for any similar use.

20. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein the centerlines of the thickness of the thin wall plus the rib of the waffle boxes from foundation to the uppermost deck are aligned.

21. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein special elements such as the end waffle wall and waffle slab and the combined waffle wall and slab are introduced at the leftmost, rightmost and topmost part, incorporating the features for joining, lifting, aligning, hauling that are shown in.

22. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein some cast-in-place structural elements like wall, beam, and other structural elements, are introduce in the system to come up with a structurally enhanced shelter or building, which will be termed "enhancing".

23. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein the following features like trapezoidal corbel and "z" corbel or inverted corbel, are designed to support and stabilize the waffle boxes.

24. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein the following features like sockets, holes, welding plate or welding angle with their matching pins, dowels, bolts, and sizes of welds are designed to join two or more waffle boxes.

25. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein the following features like vertical/horizontal target and match groove are designed for quality control and fast installation.

26. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein the following features like cylinder with bolt, rod with eye, bolt with fork or plate, socket for fork lift are designed for lifting and hauling of the waffle boxes.

27. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein the waffle boxes are made of all kinds of lightweight or standard weight concrete (standard or blended), plastic, wood or its derivative like laminated wood, metal including steel sheet or its improved products like the pre-formed, bended, punched sections, aluminum, fiberglass, or glass.

28. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein all sorts of false or formworks to cast, fabricate, mold and create and turn these waffle boxes and its components like waffle wall, waffle slab, combined waffle wall and slab, foundation, stairs, etc. into usable parts of the shelter, building or any type of box-like structure.

29. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein some waffle boxes which are positioned in parallel or perpendicular with the other waffle boxes in order to maintain structural integrity in both lateral and vertical directions of the shelter or building will introduce structural elements; example posttensioning, prestressing, etc., which will be termed "sewing" or "stitching".

30. A four (4) or six (6) side rectangular prefabricated, prefinished, plug-in or insulated product termed as type II waffle box with wings as recited in claim **17** wherein the waffle boxes are analyzed and designed using a series of

micro portal frames (series of "tee", "cee" or "I" sections running along the perimeter of the waffle boxes) including those that are purely ribs to resist all kind of loads in different directions.

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