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(54) Title: LOAD BEARING INTERLOCKING STRUCTURAL BLOCKS, MODULAR BUILDING SYSTEMS AND STRUCTURES

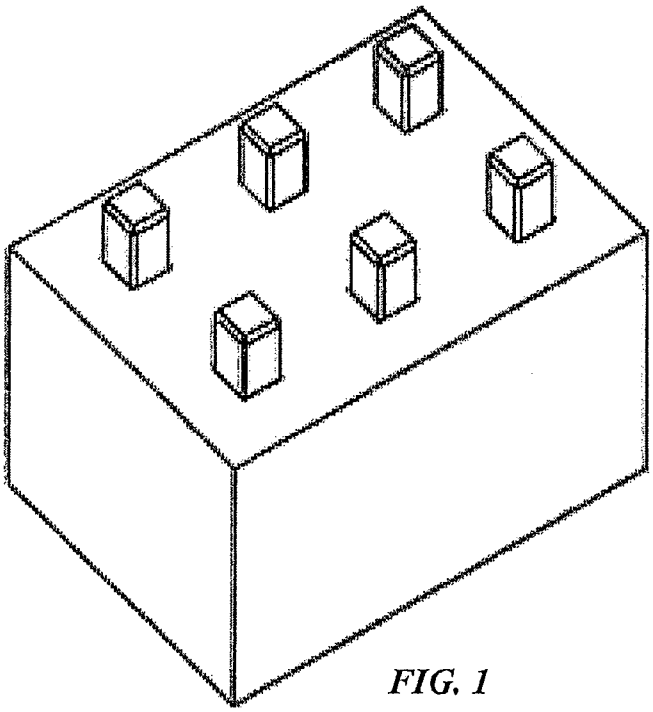

FIG. 1

(57) Abstract: Construction materials intended for use as structural elements, such as structural blocks, used in the construction of buildings and civil engineering structures. The blocks can comprise hemp hurd and fibers, flax fiber, hydraulic lime and hydrated lime. In one aspect, the blocks may comprise a body shape configured so as to allow it to interlock with other blocks in the construction of a structure. Methods for manufacturing the blocks and structures comprising such materials and methods for building such structures are also disclosed.

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LOAD BEARING INTERLOCKING STRUCTURAL BLOCKS, MODULAR BUILDING SYSTEMS AND STRUCTURES

FIELD OF THE INVENTION

[0001] The invention disclosed herein relates to particular construction materials, as well as processes for preparation and uses of such materials. Such materials may be intended for use as structural elements, such as structural blocks, used in the construction of buildings and civil engineering structures.

BACKGROUND OF THE INVENTION

[0002] The production of blocks for masonry using vegetal additions incorporated in a lime-based binder matrix (for example hemp used to produce Chanvribloc™ blocks) is a known process in the art.

[0003] The prior art also discloses blocks used in the construction of structures, such as houses and commercial buildings, which may have properties that are either insulating or load bearing.

[0004] WO 2014072533 discloses an insulating construction material with an alleged low thermal conductivity comprising vegetal additions, as well as to a process for preparation and to uses of such a material.

[0005] It would be advantageous for there to be a structural block that had a composition and configuration that integrated both load bearing capabilities with insulating properties.

[0006] It would also be advantageous for there to be further means for providing additional reinforcement and tension bearing capabilities to a structural block.

SUMMARY OF THE INVENTION

[0007] The invention disclosed herein relates to particular construction materials, as well as processes for preparation and uses of such materials. Such materials may be intended for use as structural elements, such as structural blocks, used in the construction of buildings and civil engineering structures. When the materials are used in the production of structural blocks, such blocks may integrate load bearing capabilities together with insulating properties.

[0008] In accordance with an aspect of the present invention, structural blocks are provided that may be configured to interlock with complimentary blocks in the construction of a structure. In one embodiment, the structural block may accommodate an embedded member or strut protruding from the surface of one side of the block and a recess on another side.

[0009] In accordance with another aspect of the present invention, a structure comprising a plurality of interlocking structural blocks is provided, the blocks adapted for separate sections of the structure, wherein each block is made from a primarily fibrous material and a primarily lime based material, each block comprising a plurality of embedded members, one end of each member extending from one surface of the block, and a plurality of apertures extending within the block from an opposed surface of the block to the terminating end of the embedded member, the apertures adapted for engaging an extending end of an embedded member of an adjacent block.

[0010] In accordance with a further aspect of the present invention, a method for manufacturing a structure is provided, comprising selecting dimensions for a plurality of interlocking structural blocks based upon application of the blocks in the structure, assembling the blocks to the selected dimensions, wherein each block is made from a primarily fibrous

material and a primarily lime based material, each block comprising a plurality of embedded members and a plurality of apertures, one end of each member extending from a surface of the block and a plurality of apertures extending within the block from an opposed surface of the block to the terminating end of the embedded member, the apertures formed for engaging an extending end of an embedded member of an adjacent block, cutting one or more of the blocks to a desired configuration, and assembling one or more sections of the structure by adjoining the blocks such that the extending ends of the embedded members of a block are inserted into the apertures of an adjacent block.

[0011] Further aspects, features and advantages of the present invention will be apparent from the following descriptions and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, may best be understood by reference to the following detailed description of various embodiments and accompanying drawings in which:

[0013] FIG. 1 is a front perspective view of a structural block in accordance with the present invention;

[0014] FIG. 2 is a bottom perspective view of the structural block of FIG. 1;

[0015] FIG. 3 is a bottom view of the structural block of FIGS. 1-2;

[0016] FIG. 4 is a top view of a structural block in accordance with the present invention;

[0017] FIG. 5 is a front perspective view of a structural block comprising conduits therethrough, in accordance with a preferred embodiment of the present invention;

[0018] FIG. 6 is a bottom perspective view of the structural block of FIG. 5;

[0019] FIG. 7 is a bottom view of the structural block of FIGS. 5-6;

[0020] FIG. 8 is a top view of a structural block comprising perforated struts in accordance with a preferred embodiment of the present invention;

[0021] FIG. 9 is a front view of the structural block of FIG. 8;

[0022] FIG. 10 is a side view of the structural block of FIGS. 8-9;

[0023] FIG. 11 is a perspective view of a structural block adapted to accommodate a tensioning system therethrough;

[0024] FIG. 12 shows various views and types of structural blocks adapted to accommodate a tensioning system;

[0025] FIG. 13 is a perspective view of a preferred embodiment of a tensioning system comprising a hex swage tensioner;

[0026] FIG. 14 shows various views and types of structural blocks adjoined together through a tensioning system;

[0027] FIG. 15 is a top view of a structural block adapted to accommodate a compression strut in accordance with the present invention;

[0028] FIG. 16 is a front view of the structural block of FIG. 15;

[0029] FIG. 17 is a side view of the structural block of FIGS. 15-16;

[0030] FIG. 18 is a front view of another structural block adapted to accommodate a compression strut in accordance with the present invention;

[0031] FIG. 19 is a side view of the structural block of FIG. 18;

[0032] FIG. 20 is a back view of the structural block of FIGS. 18-19; and

[0033] FIGS. 21-33 show various views of a construction of a building in accordance with the present invention using the blocks of the present invention;

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0034] The present invention relates to particular construction materials, as well as processes for preparation and uses of such materials. When describing the present invention, any term or expression not expressly defined herein shall have its commonly accepted definition understood by those skilled in the art. To the extent that the following description is of a specific embodiment or a particular use of the invention, it is intended to be illustrative only, and not limiting of the invention, which should be given the broadest interpretation consistent with the description as a whole.

[0035] The construction materials of the present invention are intended for use in structural elements for building structures and civil engineering structures.

[0036] In one embodiment, the materials are used in the production of structural blocks. In one aspect, the blocks of the present invention may be designed so as to integrate compression and torsional load bearing capabilities with insulation properties.

[0037] FIGS. 1-4 illustrate structural blocks in accordance with preferred embodiments of the present invention. As illustrated in FIGS. 1-4, each block of the present invention may comprise a body shape configured so as to allow it to interlock with other blocks when constructing a structure, such as a wall or house. Such design can provide further strength to the overall structure.

[0038] In one embodiment, each block can accommodate one or more embedded member. The member, which may also be termed a strut in the art, may be embedded within the block or inserted during building construction and may contribute to the load bearing properties of the block, particularly compression loads. One end of the embedded member may protrude out a given distance from one side of the block, while the opposite end of the embedded member may terminate partway within the block on an opposite side.

[0039] In another embodiment, the embedded member may be flush with the surface of the block and a positioning device may also be used to align and join the members together. For example, a tube with directional clips may be used between blocks to grip the abutting member ends in adjacent blocks.

[0040] A recess or opening can be formed within the block and can extend from the terminating end of the embedded member within the block through to the surface of a side of the block, opposite to the side through which the embedded member protrudes.

[0041] In one embodiment, the extended end of the embedded member may protrude from the block by a distance that is approximately equivalent to the depth of the recess within the block. By way of example, a block with a height of 8 inches may accommodate an embedded member that is 8

inches in length. The protruding end of the member may extend 2 inches out from the surface of one side of the block, with the remaining 6 inches embedded within the block. A recess formed within the block at the member's opposite end may be 2 inches in depth. The recess may extend immediately from the terminating end of the embedded member housed in the block, to the surface of the opposite side of the block.

[0042] A recess can be of a size, shape and may be spaced apart from one another so as to align with and accommodate the protruding end of an embedded member of another block. Such an arrangement may be similar to an interlocking "pin and socket" arrangement and can function as a locating means for the purpose of accurately positioning a block with respect to an additional block(s) while also contributing to the load bearing attributes of the block under compression.

[0043] When the protruding end of an embedded member of one block is positioned into the corresponding recess of a second block, the protruding end of the embedded member may be in direct contact with the terminating end of the embedded member of the second block. As a result, the blocks can be said to auto align, and the embedded members can be said to form a stacked structure forming a load bearing structural member.

[0044] For ease of assembly, a recess within the block may have a width that is some measurement greater than the width of the embedded member. In one embodiment, the width of the recess may be 1/4 inch wider than the width of the member, for example, 1/8 inches on either side of the recess (on each of the four sides when the block and recess are square), to accommodate ease of insertion of the protruding member of an adjacent block.

[0045] Any suitable binding agent, such as lime mortar for example, may be used to bind the protruding end of an embedded member of one block into the corresponding recess of a second block. Such a bond, when formed, may be stronger than the block itself.

[0046] When the embedded member and corresponding recess are interlocked, a molecular bond may be formed that can contribute to the load bearing or other structural properties of the block. In some instances, the load bearing capabilities of the block of the present invention may be several times greater than that of a hollow concrete block, and more similar to or exceeding that of a conventional stud-framed wall structure.

[0047] In another embodiment, holes may be created on the block that may be positioned an equal distance between the embedded members. As illustrated in FIGS. 5-7, the holes may be used to create a conduit to accommodate electrical wiring or other utilities inside, for example, a structure's wall. The holes may also be beneficial to the curing process, by exposing the block's interior, for example, to injected carbon dioxide. In an alternate embodiment, some strut members may be hollow and slotted. As illustrated in FIGS. 8-10, in another embodiment, additional perforated tubes or struts may be incorporated in the blocks therethrough.

[0048] The composition of the member or strut itself may comprise any rigid material or mixtures thereof, with any preferences to materials used directed to cost considerations and load bearing capabilities of the material. In a preferred embodiment, the embedded member may comprise any wooden material, such as fir, spruce, pine, cedar, etc. The element may also comprise composites of organic or inorganic fibers, such as hemp or carbon fiber, etc. In yet a further embodiment, the embedded member may comprise a blend of bio fibers and polymers, such as polyethylene,

polypropylene or polyester. Some compatible metals may also be used. A member or strut may also be hollow, such as a hollow square or cylindrical tube. Other materials may include metals, carbon fibre or composites, 3D printed or extruded plastics or any suitable structural members.

Tensioning System

[0049] In one embodiment, the block of the present invention may be adapted so as to be tension bearing as well. As illustrated in FIGS. 11-12, a block may be further adapted so as to accommodate a tensioning system that can provide tension. In such an embodiment, the embedded member of the block can accommodate a tensioning means though the length of the member, such tensioning means entering through the one end of the member and exiting through the other end of the member.

[0050] In one embodiment, the tensioning means may be a cable, such as, for example, a tensioned non-stretch stainless steel cable. In an alternate embodiment, the system may comprise a rod.

[0051] As illustrated in FIG. 13, when the tensioning system includes a cable, the tensioning end assembly can comprise a hex swage tensioner, in addition to the cable.

[0052] As illustrated in FIG. 14, when assembled, the embedded members of each block can be aligned with the corresponding members of other blocks, to allow the passage of the tensioning means through multiple embedded elements and blocks.

[0053] Such a configuration provides a further fastening means for a structure comprising the blocks of the present invention. In particular, such a configuration may be tension bearing, in that the blocks may be adjoined

together through tension suitable for non-vertical structural elements such as floors, walls, pitched or flat roof surfaces, etc.

[0054] In another embodiment, an additional member, which may be termed a compression strut, can be used for the purpose of increasing the compression strength of the structural element formed by tensioned blocks. As illustrated in FIGS. 15-20, a compression strut may, for example, be placed approximately perpendicular between and in contact with a pair of existing members or struts integrated into the body of the block each of which accommodates a cable as tensioning means. The application of the compression strut in this embodiment may assist in keeping the embedded member pair properly spaced, without needing structure inherent in the block material, keeping the adjacent pairs of tensioned struts and cable or rod essentially equidistant throughout their length.

[0055] Other elements such as strut caps and/or mounting plates may be used in accordance with the present invention. By way of example, a strut cap may be set into a block over the protruding end of an embedded member, with the extending end extruding from the cap.

[0056] In practice, the tensioning means may be tensioned post construction, after the blocks have been aligned.

[0057] When the tensioning means comprises a cable, the tensioning procedure with regard to a roof, for example, may include the following steps:

(i) Beams may be assembled using the tension blocks on a flat horizontal surface and pre tensioned by use of cables and lifted into position. Alternatively scaffolding would be required to assemble in place and post tension the blocks using cables.

(ii) Once the roof is constructed (minus the end caps) the non-swaged end of the cable is fed through the embedded member, starting at the peak of the roof.

(iii) The cable is pulled taught.

(iv) The second end of the cable is swaged as close to the hex tensioner as possible.

(v) The hex tensioner is tightened as much as needed.

[0058] In one embodiment, the frequency of tensioning means may need be applied only as required, for example, every meter of the assembled structure, to form a floor, roof, or other non-vertical structure, or can be a wall.

Bio-Fiber Structural Block

[0059] In a preferred embodiment, the body of the block of the present invention can comprise a primarily fibrous and lime composition. Specifically, the composition for each block may comprise the following components:

(i) hemp hurd, and fibers

(ii) flax fiber

(iii) hydraulic lime

(iv) hydrated lime

[0060] Certain benefits may be realized through the practice of a block comprising the preferred composition of the present invention. Compositions comprising hemp hurd, flax, hydraulic lime and hydrated lime may be environmentally sustainable, recyclable and may sequester carbon

dioxide from the atmosphere, while providing exceptional insulating qualities.

[0061] While a concrete block may need to be restricted in size, for example 16 inches, due to weight for handling, a block of the present invention may have a length of 48 inches or more and may maintain ease of handling because of its lower density, for example, 300kg/ cubic meter.

[0062] The lime component may primarily act as a binding agent, holding the other components together. However, any suitable binding agent may be substituted in instances, for example, when a stronger bonding agent may be required. Suitable alternative binding agents can include polymer based agents, for example silica sand, pozzolans, polyester resins, or Portland or similar cement or plaster. Such alternative agents may also be used in combination with the lime component of the preferred embodiment.

[0063] The hemp hurd and fiber component can provide insulating properties, bulk, support and strength to the block and structural members in the block. However, any alternate material or combination of materials that can provide similar desirable properties may be used in the alternative. Some organic alternatives include fibrous materials, such as corn stocks, cereal grain, straw, etc. Hemp hurd is a preferred material, primarily due to its insulating qualities in relation to the other fibers.

[0064] Alternatively, non-organic materials such as Styrofoam/polystyrene or non-recyclable plastics may be used. Such materials may also be used in a shredded form. Structural fibers (oriented cellulose strands, plastics, metal or carbon filaments) may also be incorporated or substituted. The application of these non-organic alternatives may provide an additional advantage, in that such non-recyclable materials may be sequestered from

the environment, or may add different qualities to the blocks (strength, conductivity, electrical or RF shielding, noise abatement, etc.).

Recyclable and Sustainable

[0065] The composition of a preferred embodiment comprises hemp hurd, flax, hydraulic lime and hydrated lime. The primarily fibrous-lime combination is organic and composed of bio-recyclable material. When the useful life of a structure that uses such blocks comes to an end, its components may be recycled. For example, the entire block may be ground up and remixed for further subsequent applications.

[0066] The components of the composition are also sustainable. For example, hemp hurd, in addition to its favorable properties, is readily available in supply and grows very quickly with little water and fertilizer.

[0067] Other favorable properties may be realized by the fibrous-lime composition of the preferred embodiment. In particular, such a combination allows the building to "breathe". Air and humidity can pass both in and out of the blocks at a very slow rate. No vapor barrier may be required to be used.

[0068] The composition may also be resistant to mold, termites and other insect pests.

[0069] A structure using the block composition of the preferred embodiment may allow for fire resistance, due to the properties of the hemp hurd and lime mixture, or other compositions.

[0070] In another embodiment, the blocks of the present invention may be further coated with a lime finish. A block of the present invention may be coated with several, for example five or more, coats of lime.

[0071] A structure using the blocks of the present invention can be bonded to become monolithic. Such properties can be especially beneficial particularly in areas prone to earthquakes, hurricanes or tornados.

[0072] Water proofing or moisture resistant properties may also be realized, particularly by use of the lime component. The lime component can also allow a block of the preferred embodiment to "heal" itself. For example, a crack in the lime coating can close over time when it is subjected to moisture.

Carbon Dioxide Sequestration

[0073] The carbon dioxide sequestration properties of a block that comprises the preferred composition of the present invention allows for the removal and sequestration of the greenhouse gas carbon dioxide from the Earth's atmosphere.

[0074] The hemp hurd component of the composition can sequester carbon dioxide at a rate of over approximately 20 tonnes per hectare as the plants grow.

[0075] It is estimated that the hemp hurd-lime composition blocks of the preferred embodiment have the capability to capture/absorb over approximately 100 kilograms of carbon dioxide per cubic meter. The lime component can use carbon dioxide to cure and set the mixture. An average house comprising such blocks, for example, can capture approximately 13,000 kilograms of carbon dioxide during block production and can continue absorbing carbon dioxide for approximately 100 years.

Methods of Manufacture

[0076] The fabrication of the blocks of the present invention may be attained by means using a mold process.

[0077] During manufacture, the embedded members or struts may be cut to the desired length, such as, for example, 8 inches in length. A hole may be drilled through the lengths of the bodies of those members that will serve as conduits for the tensioning means.

[0078] A desired number of struts and perforated tubes are placed into a mold at the desired positions, in a jig.

[0079] A mixture comprising the components of the block's composition may be combined and mixed. The mixture may then be, for example, poured, sprayed or injected into the mold.

[0080] The composition may be compressed and/or heated and allowed to set. During the curing process, carbon dioxide may be injected or passed by (or through conduits within) the curing block, which decreases the cure time. Depending on the lime composition used, the blocks may also be cured in an autoclave to control the temperature, humidity and carbon dioxide environment.

[0081] A lime coating may be applied to the inner and outer face of the blocks at time of manufacture which may increase the block strength and reduce construction finishing time.

[0082] The blocks of the present invention may be pre-manufactured and then cut as desired on site.

Building Structure and Related Materials

[0083] A structure and related building materials is also disclosed by the present invention, as illustrated in FIGS. 21-33.

[0084] In a preferred embodiment, such building materials may include blocks as disclosed in the present invention. Consequently, the blocks

used in the structure of the present invention may be load bearing, tension bearing and insulating.

[0085] The blocks used may be of standard building construction dimensions. Height width and length may vary, depending upon the application, orientation and desired insulation requirements. For example, the blocks used for the walls of a structure may be a standard 11" thick and 8" high, while varying in length. Roof structure blocks may be 12" high and 16" wide.

[0086] The building materials may also be pre-manufactured prior to being transported to an intended building site for assembly.

[0087] A 1400 square foot house structure is provided by way of example below.

Wall blocks

[0088] The wall blocks can be of a standard height and width, and may vary in the length. The wall blocks may be a standard 11" deep and 8" high, and may vary in the length. The total count below includes blocks that may be cut on site.

4": 8

8": 12

12"-2 struts: 13

12"-4 struts: 29

16": 7

20": 13

24": 63

32":97

36": 43

48": 644

Total wall block count: 929

48" wall starter strips-(may be made of pressure treated plywood):65

Roof blocks

R = roof

Ed = edge (always 48")

S = starter

E = end

P = peak

Total counts include blocks that may be cut on site.

R24': 1

R32": 2

R48": 198

Red: 20

Re24: 2

Re32: 1

Re48: 19

Reed: 2

Rs24: 1

Rs48": 23

Rsed: 2

Rp24": 2

Rp48": 21

Rped: 2

Total roof block count: 296

Beam blocks

Standard 16": 36

16" end block: 1

16" end cap: 2

Standard 12": 4

12" end cap: 1

Total beam block count: 44

Structural ties

[0089] Structural ties may be breathable and in one embodiment, may be made from 16 gauge stainless steel mesh.

Roof/wall structural tie: 23

Peak tie: 30

Square mesh tie: 25

Structural bracket: 5

Wood (rough cut unless noted otherwise)

1 1/2"x12"x12" under 12" beam: 1

1 5/8" x12"x16" under 16" beam: 2

2'x6' roof starter block support (1 each):

37' – 8" long

35' – 8" long

11' – 8" long

2' long

2x6 window/door headers and footers (dressed):

6' – 4" long: 2 (master bedroom window)

9' long: 2 (living room window)

5' long: 1 (front door)

8'- 4" long: 1 (back door/window)

3' – 8 ½" long: 1 (back window footer)

6' long: 4 (bedroom windows)

2x4 window/door trim (dressed)

6' – 8" long: 4 (doors)

3' – 4" long: 8 (windows – not living room)

4' – 8" long: 2 (living room windows)

Fasteners

[0090] The fasteners used should be compatible with lime construction and can include stainless steel or ceramic coated fasteners.

Finish of the structure

[0091] In an embodiment of the present invention, lime mortar or another suitable mortar may be brushed on all block faces that are adjacent to another block face. As a result, this can create a structure that is monolithic and sealed.

[0092] The interior walls of the structure of the present invention may be a lime rendering, which may be colored or have breathable paint applied over it. In an alternative embodiment, there is no further application required to

the interior walls. In another embodiment, the interior walls may also be covered in panels of sheetrock, wood veneer or brick, preferably with approximately a minimum 1" air space constructed between the bricks and the interior paneling.

[0093] The exterior walls of the structure of the present invention may have a plain coat bio-fiber and lime finish applied. Such an application can add to monolithic quality and building strength with a more finished look and a non-fading or fading resistant color finish. In another embodiment, the exterior walls can have a mortar application, or "stucco look". Such an application can also add to monolithic quality and building strength with a more finished look and a non-fading or fading resistant color finish. In a further embodiment, typical wall siding brick veneer and other non permeable materials may be used, and should maintain a minimum 1" space from the block surface. In yet another embodiment, there is no further application required to the exterior walls, and the blocks may be formed with a decorative exterior surface on them. The blocks may have embossed or patterned surfaces for decorative or other purposes such as sound absorption, water-shedding, light reflectivity and so on.

[0094] Any roofing material known in the art may be used in conjunction with the roof of the present invention structure. If non-breathable material is used, there should be an approximately one inch minimum space between the non-breathing material and the roof block. In one embodiment, the roof may be coated, for example, with a 7 coat, 100 year lime finish. In an alternative embodiment, the roof may further comprise bio-fiber breathable "clay-like" tiles which may not require an air space.

Preferred proposed block benefits

[0095]A most preferred embodiment of the present invention would possess some or all of the following characteristics:

- Strong load bearing capabilities
- Excellent insulating properties R26 to R40 or λ = 0.07W/m.K with 100% thermal break
- Excellent fire rating
- Environmentally sustainable, Carbon zero or negative co2 building material classification
- Good thermal inertia and thermal mass characteristics to regulate inside temperature
- Excellent air and humidity permeability
- Conforms to existing building standards and dimensions making it easy for contractors and architects to implement. Conventional fasteners such as stainless steel or Ceramic coated screws may be used
- Lightweight for ease of handling and requires no skilled labour for construction assembly
- Very rapid construction, Constructed walls are weatherproof and finishes may be applied immediately. Factory prepared face surfaces require minimal interior and exterior finishing
- Standard sizes may permit robotic or machine-assisted assembly at site

- Integrated conduit paths within blocks to accommodate electrical and utilities

[0096] In the preceding description, for purposes of explanation, numerous details are set forth in order to provide a thorough understanding of the embodiments of the invention. However, it will be apparent to one skilled in the art that these specific details are not required in order to practice the invention.

[0097] The above-described embodiments of the invention are intended to be examples only. Alterations, modifications and variations can be effected to the particular embodiments by those of skill in the art without departing from the scope of the invention.

WHAT IS CLAIMED IS:

1. A structure comprising a plurality of interlocking structural blocks, the blocks adapted for separate sections of the structure, wherein each block is made from a primarily fibrous material and a primarily lime based material, each block comprising a plurality of embedded members, one end of each member extending from one surface of the block, and a plurality of apertures extending within the block from an opposed surface of the block to the terminating end of the embedded member, the apertures adapted for engaging an extending end of an embedded member of an adjacent block.

2. The structure of claim 1, wherein the blocks are adapted for use as roof blocks, wall blocks, beam blocks or floor blocks.

3. The structure of claim 2, further comprising a plurality of structural ties.

4. The structure of claim 2, further comprising one or more headers or footers for a window or door.

5. The structure of claim 2, further comprising a sealing agent coating one or more adjacent block surfaces.

6. The structure of claim 5, wherein the sealing agent is a primarily lime mortar.

7. The structure of claim 2, further comprising a primarily lime material coating an inner surface of one or more of the wall blocks forming an interior surface of the structure.

8. The structure of claim 7, wherein the primarily lime material is colored.

9. The structure of claim 7, further comprising a substantially breatheable paint coating the primarily lime material.

10. The structure of claim 2, further comprising one or more panels overlaying one or more interior surfaces of the structure.

11. The structure of claim 10, wherein a space is provided between the one or more panels and the interior surfaces of the structure.

12. The structure of claim 2, further comprising a bio-fiber and lime finish coating an external surface of one or more of the wall blocks forming an exterior surface of the structure.

13. The structure of claim 2, further comprising mortar coating an external surface of one or more of the wall blocks forming an exterior surface of the structure.

14. The structure of claim 2, further comprising one or more panels overlaying an exterior surface of the structure.

15. The structure of claim 14, wherein a space is provided between the one or more panels and the exterior surfaces of the structure.

16. The structure of claim 15, wherein the one or more panels comprise a substantially non permeable material.

17. The structure of claim 2, further comprising a decorative external surface on one or more of the wall blocks forming an exterior surface of the structure.

18. The structure of claim 2, further comprising a coating material on an external surface of one or more of the roof blocks.

19. The structure of claim 18, wherein the coating material comprises bio-fiber tiles.

20. The structure of claim 18, wherein the coating material is a lime finish.

21. A method for manufacturing a structure comprising:

selecting dimensions for a plurality of interlocking structural blocks based upon application of the blocks in the structure;

assembling the blocks to the selected dimensions, wherein each block is made from a primarily fibrous material and a primarily lime based material, each block comprising a plurality of embedded members and a plurality of apertures, one end of each member extending from a surface of the block and a plurality of apertures extending within the block from an opposed surface of the block to the terminating end of the embedded member, the apertures formed for engaging an extending end of an embedded member of an adjacent block;

cutting one or more of the blocks to a desired configuration; and

assembling one or more sections of the structure by adjoining the blocks such that the extending ends of the embedded members of a block are inserted into the apertures of an adjacent block.

22. The method of claim 21, wherein the sections of the structure comprise one or more of a roof, wall, beam, or floor and the application of the blocks are for use as roof blocks, wall blocks, beam blocks or floor blocks.

23. The method of claim 21, wherein one or more of the blocks are pre-manufactured and transported to an intended site for manufacture of the structure.

24. The method of claim 21, wherein the step of cutting one or more of the blocks is at an intended site for manufacture of the structure.

25. The method of claim 21, further comprising the step of applying a binding agent for binding the embedded member of a first block into an aperture of an adjacent block, when adjoining the blocks together.

26. The method of claim 21, wherein the binding agent is lime mortar, polymer based agent, cement, plaster, or any combination thereof.

27. The method of claim 22, further comprising the step of cutting one or more of the walls of the structure for the purpose of forming one or more windows and one or more doors.

28. The method of claim 21, further comprising the step of forming one or more conduits through one or more of the structural blocks for accommodating wiring, piping or utilities.

29. The method of claim 21, further comprising the step of applying a sealing agent on one or more adjacent block surfaces.

30. The method of claim 29, wherein the sealing agent is a primarily lime mortar.

31. The method of claim 21, further comprising the step of applying a primarily lime coating on interior surfaces of the structure.

32. The method of claim 31, further comprising overlaying one or more panels over interior surfaces of the structure.

33. The method of claim 22, further comprising the step of coating one or more of the plurality of wall blocks forming an exterior surface of the structure with a bio-fiber and lime finish, or with mortar.

34. The method of claim 22, further comprising the step of overlaying one or more panels over exterior surfaces of the structure.

35. The method of claim 34, wherein the one or more panels comprise a substantially non permeable material.

36. The method of claim 21, further comprising the step of forming a decorative exterior surface of one or more of the structural blocks.

37. The method of claim 22, further comprising the step of coating one or more surfaces of the roof blocks.

38. The method of claim 37, wherein the coating comprises bio-fiber tiles.

39. The method of claim 22, wherein the coating comprises a lime finish.

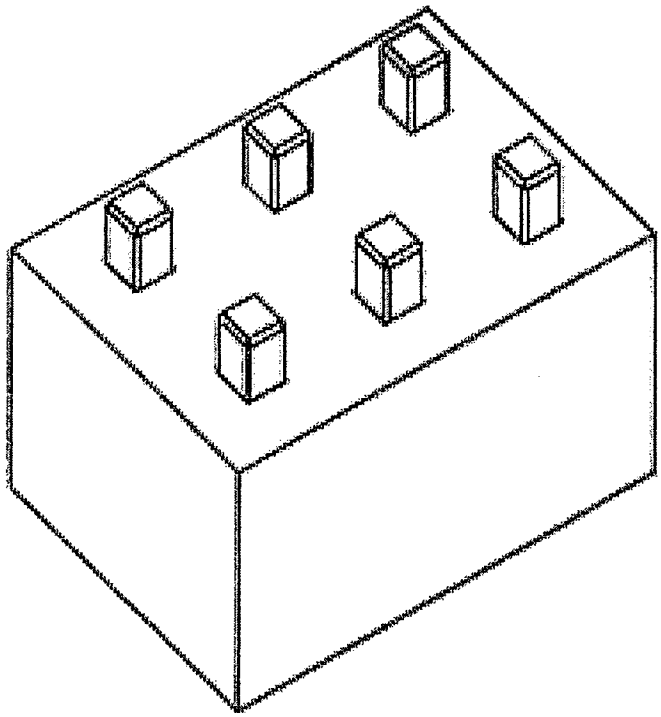

FIG. 1

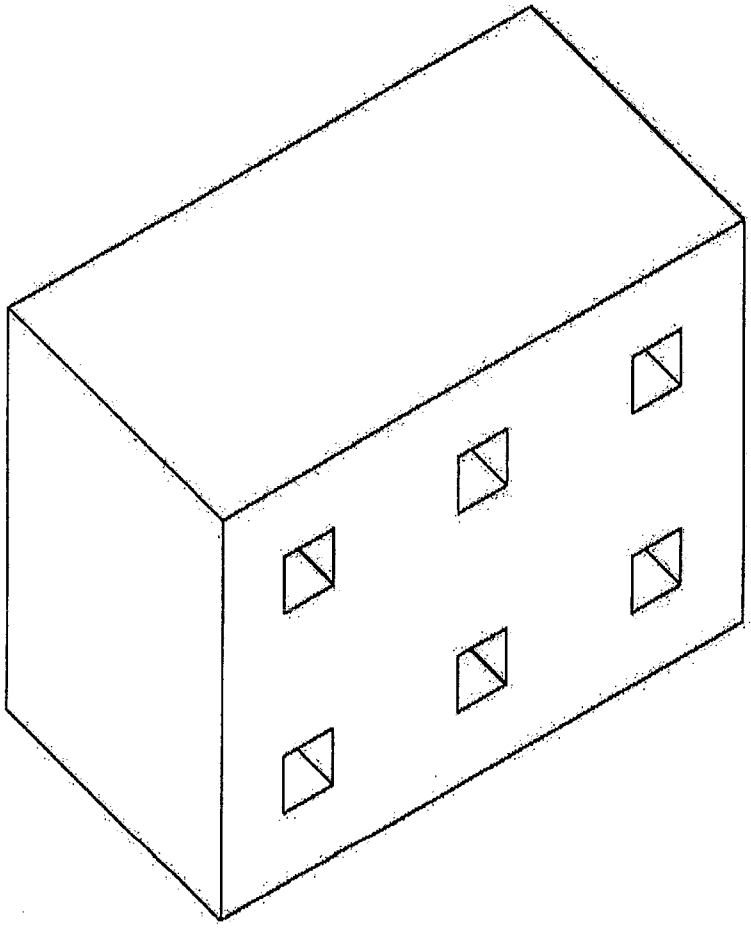

FIG. 2

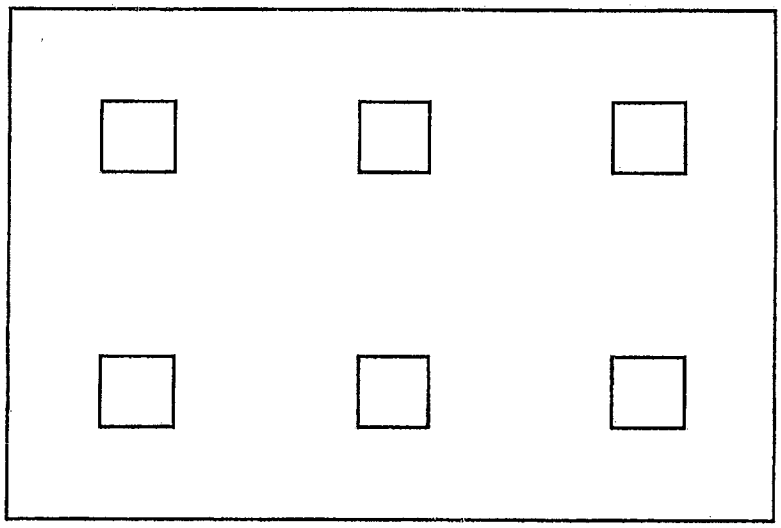

FIG. 3

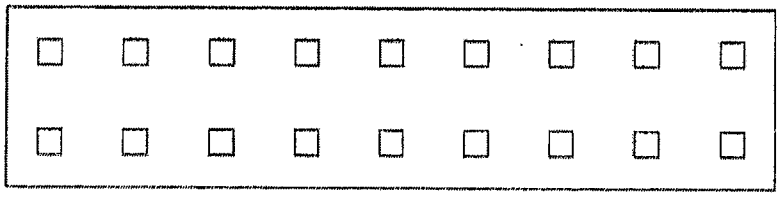

FIG.4

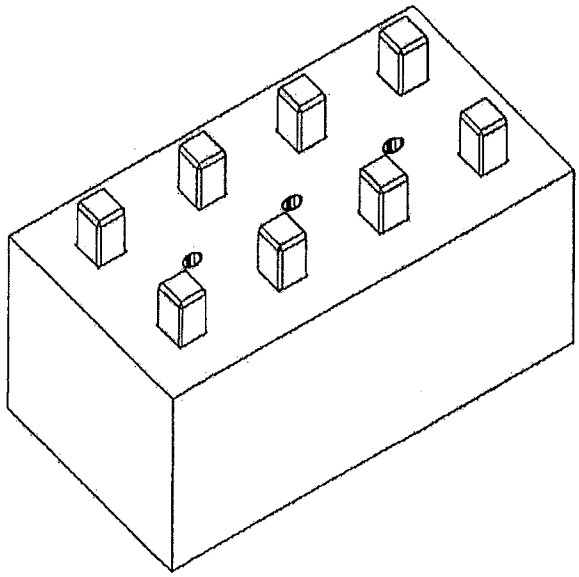

FIG. 5

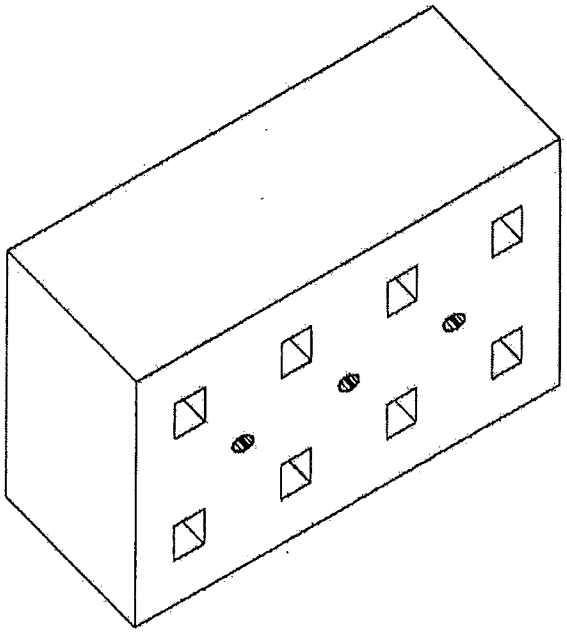

FIG. 6

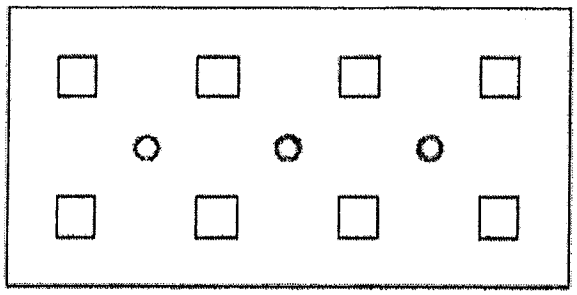

FIG. 7

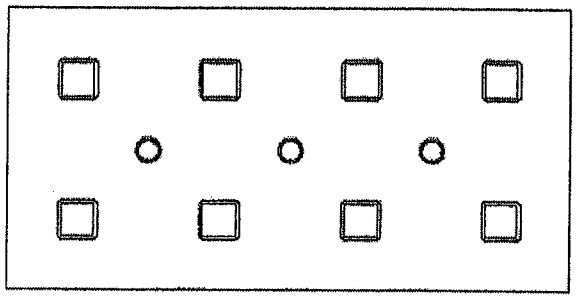

FIG. 8

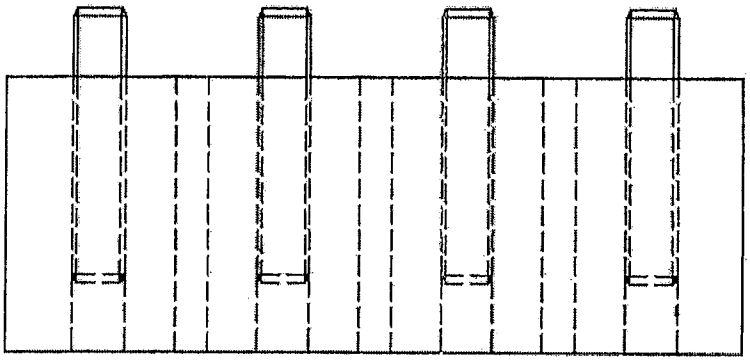

FIG. 9

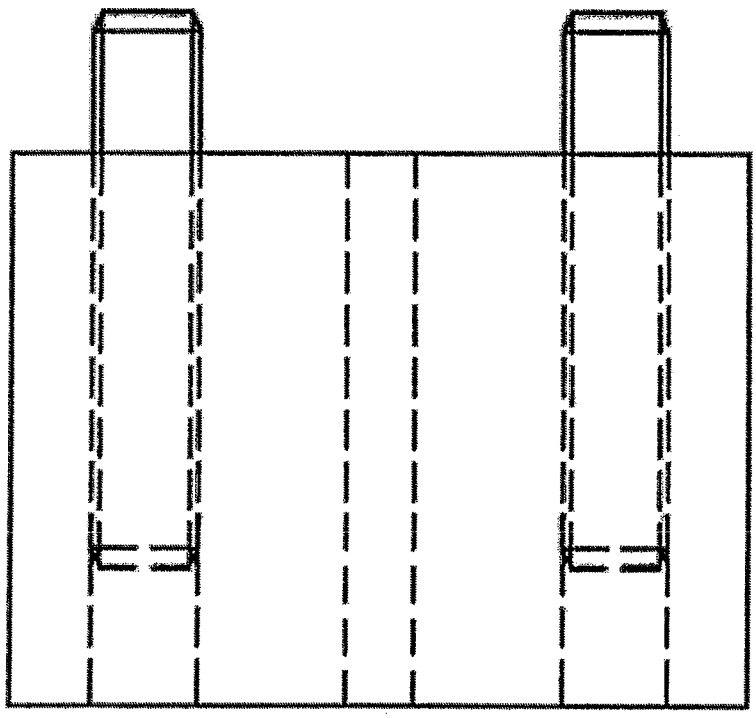

FIG. 10

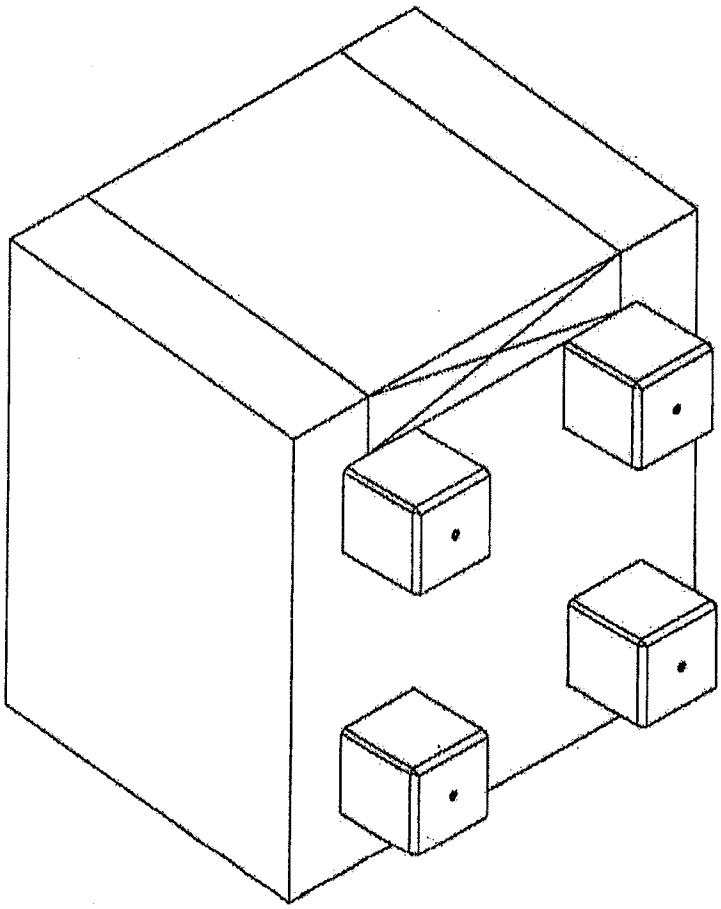

FIG. 11

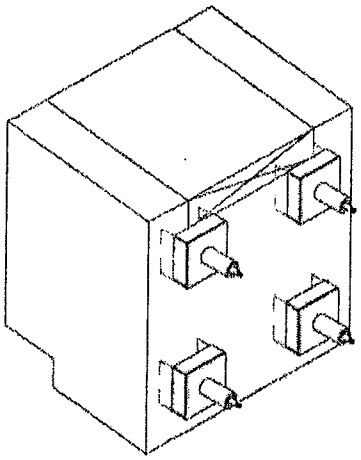

FIG. 12A

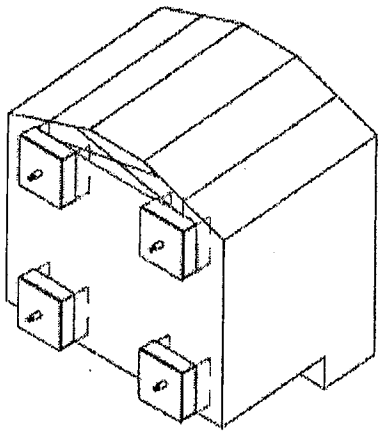

FIG. 12B

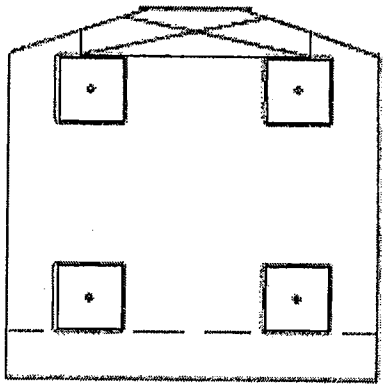

FIG. 12C

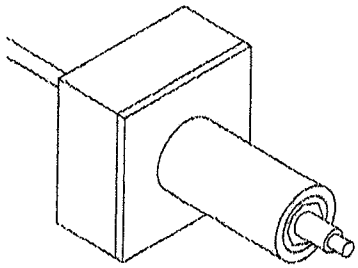

FIG. 13

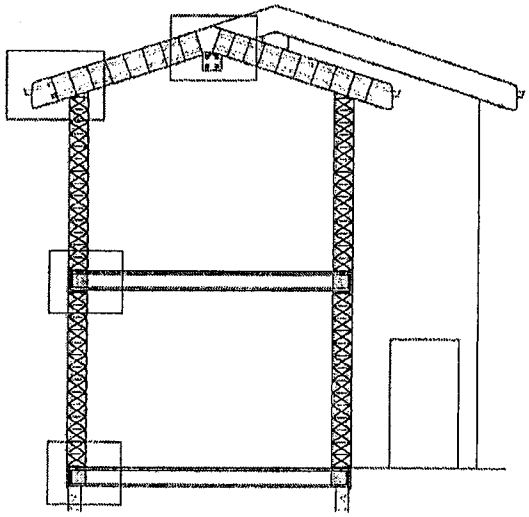

FIG. 14A

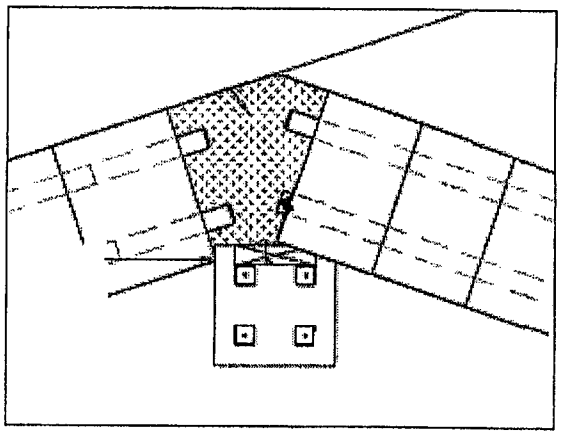

FIG. 14B

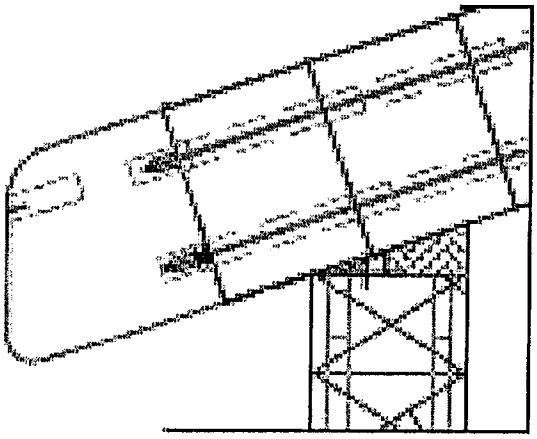

FIG. 14C

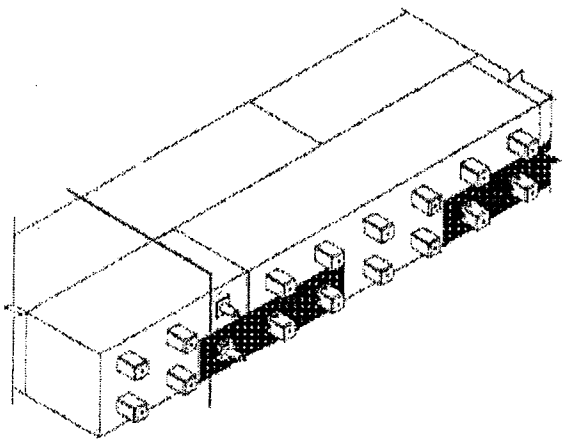

FIG. 14D

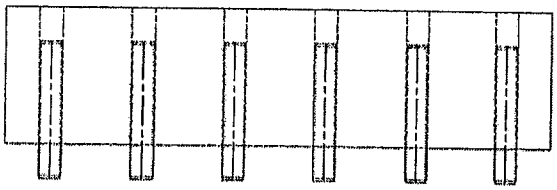

FIG. 15

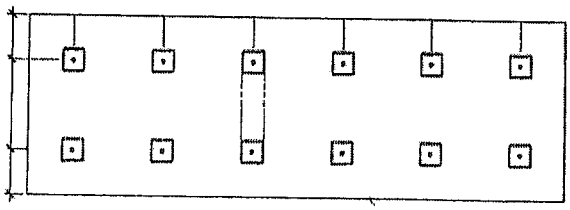

FIG. 16

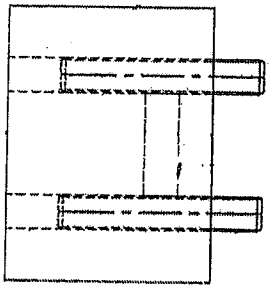

FIG. 17

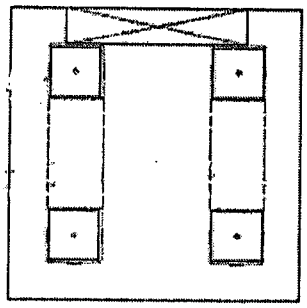

FIG. 18

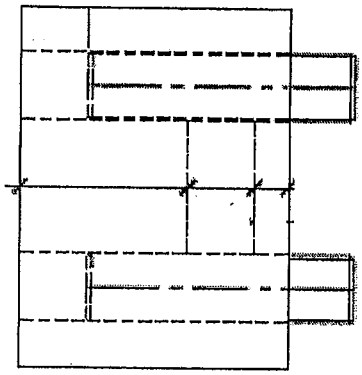

FIG. 19

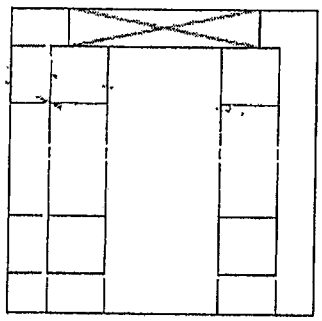

FIG. 20

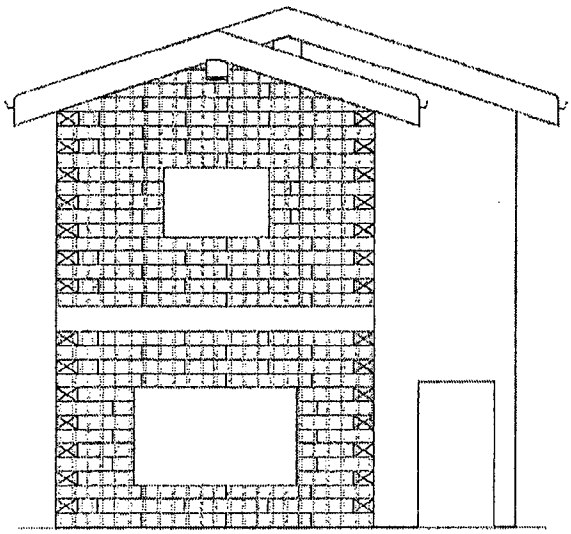

FIG. 21

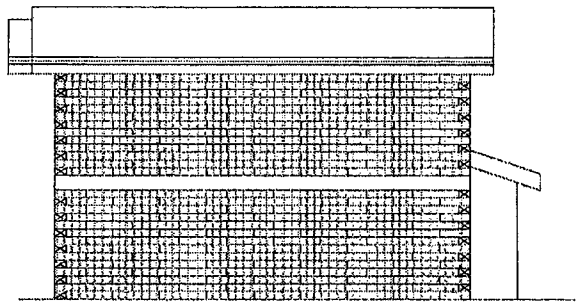

FIG. 22

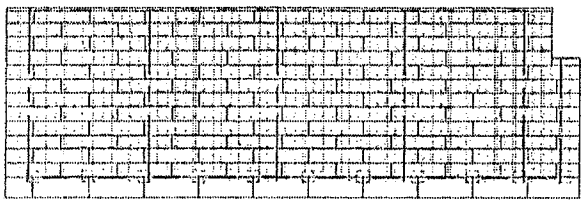

FIG. 23

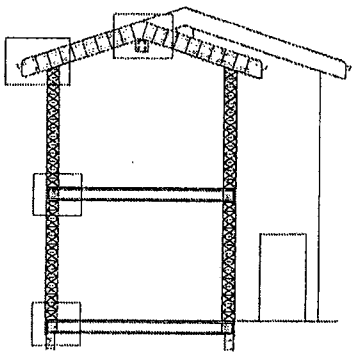

FIG. 24A

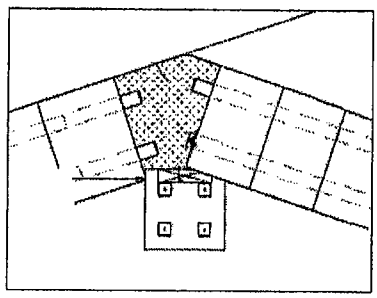

FIG. 24B

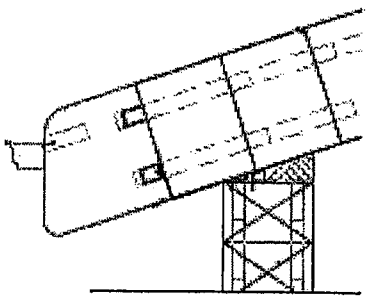

FIG. 24C

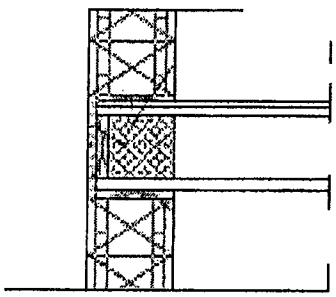

FIG. 24D

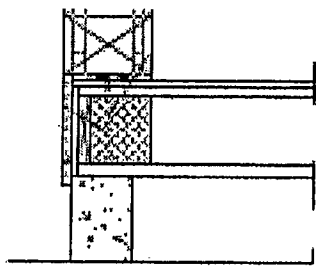

FIG. 24E

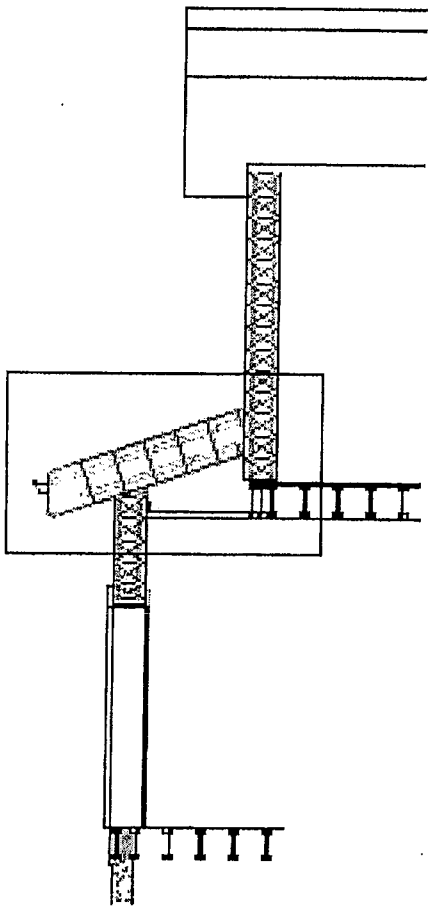

FIG. 25A

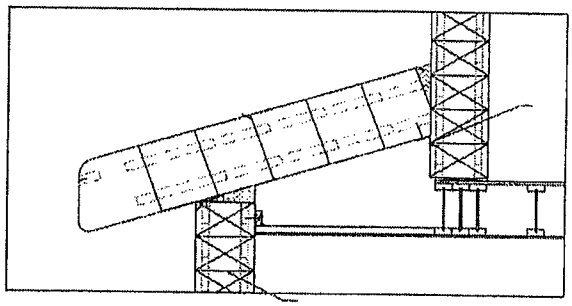

FIG.25B

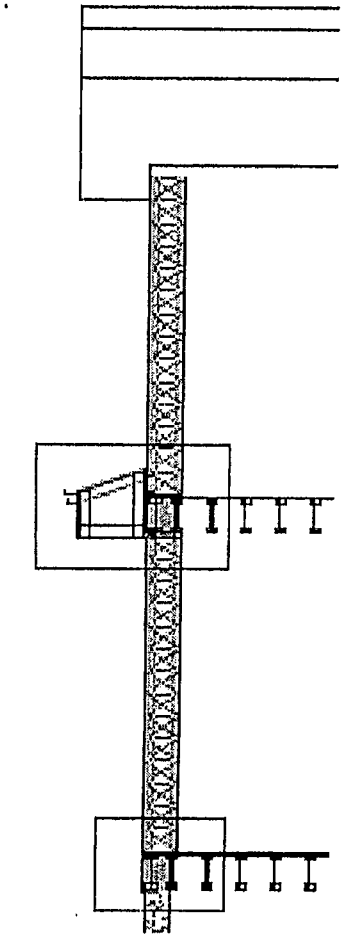

FIG. 26A

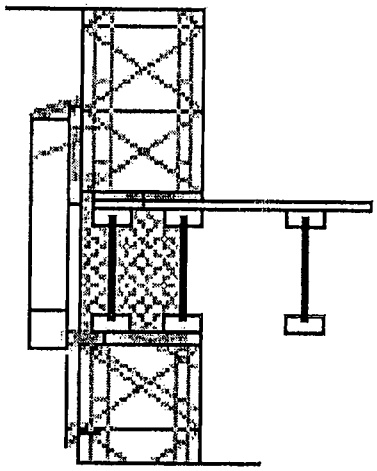

FIG. 26B

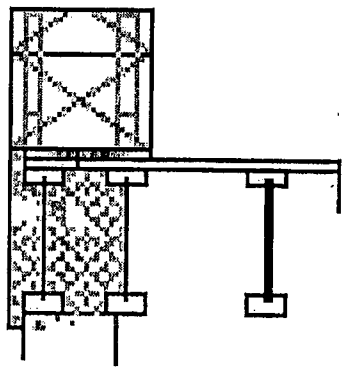

FIG. 26C

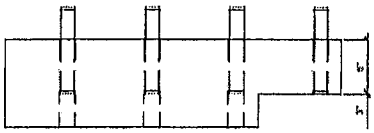

FIG. 27A

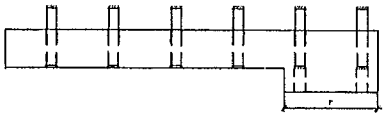

FIG. 27B

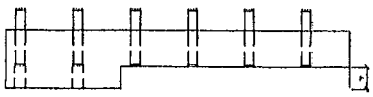

FIG. 27C

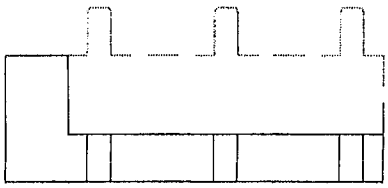

FIG. 27D

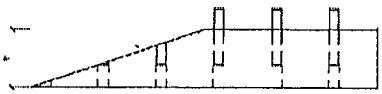

FIG. 27E

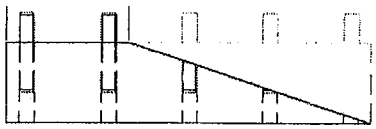

FIG. 27F

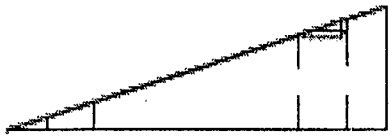

FIG. 28A

FIG. 28B

FIG. 28C

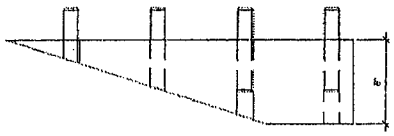

FIG. 28D

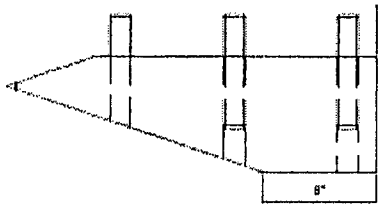

FIG. 28E

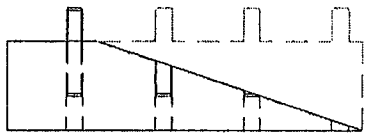

FIG. 28F

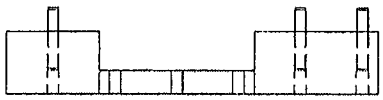

FIG. 28G

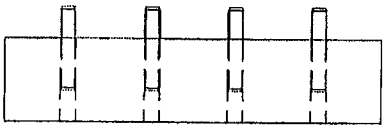

FIG. 29A

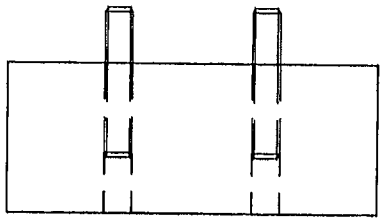

FIG. 29B

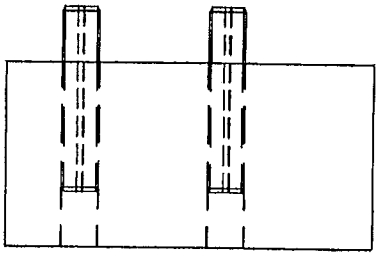

FIG. 29C

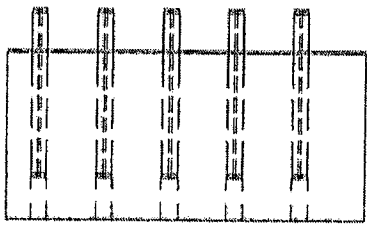

FIG. 29D

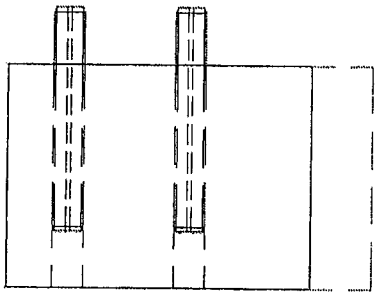

FIG. 29E

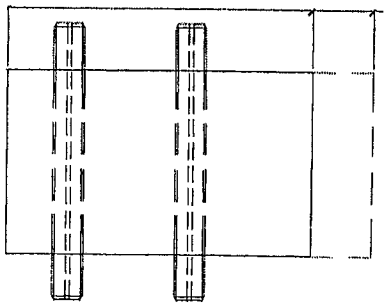

FIG. 29F

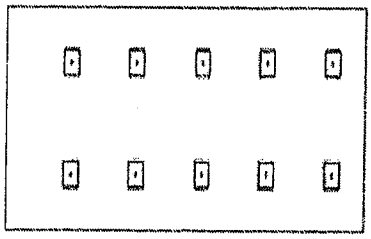

FIG. 29G

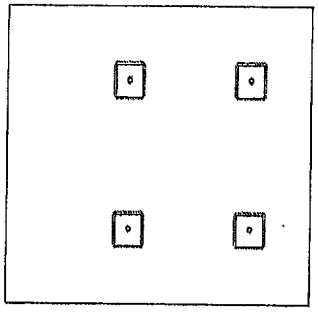

FIG. 29H

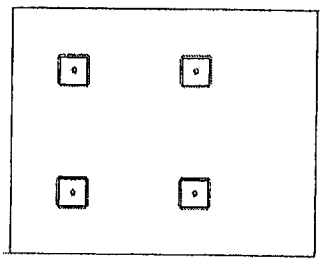

FIG. 29I

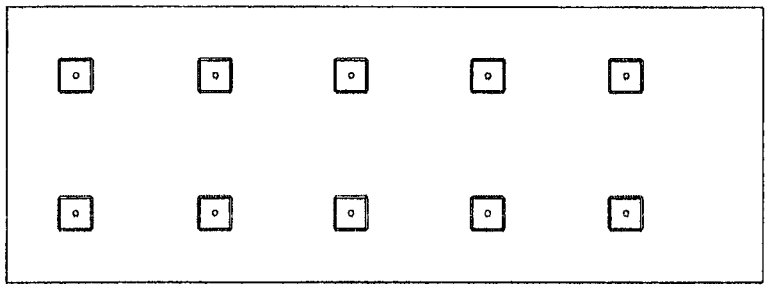

FIG. 30A

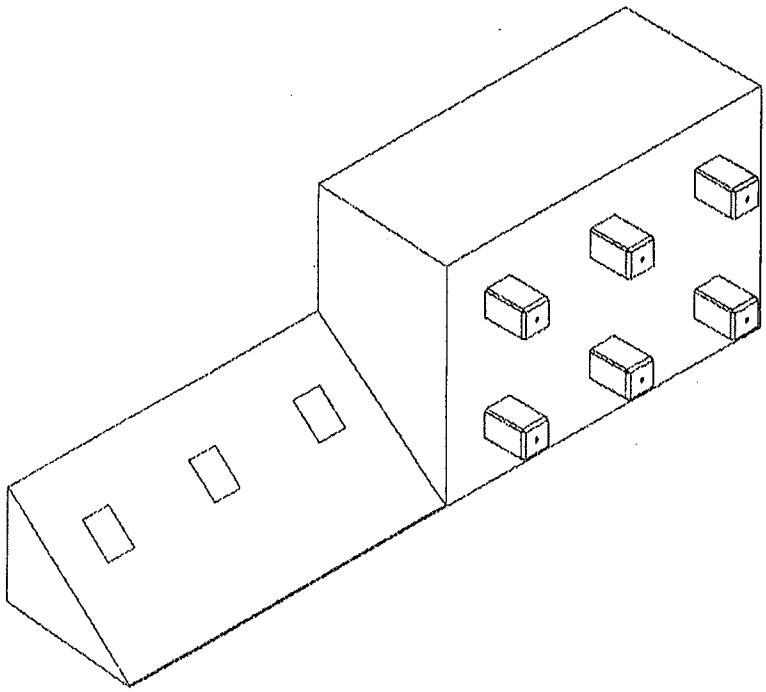

FIG. 30B

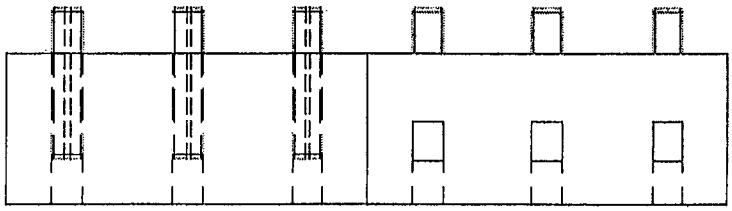

FIG. 30C

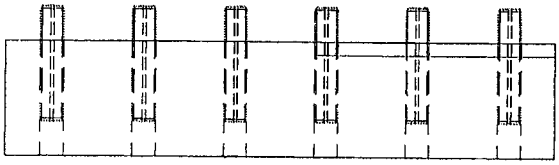

FIG. 30D

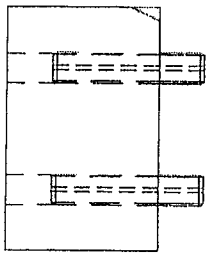

FIG. 30E

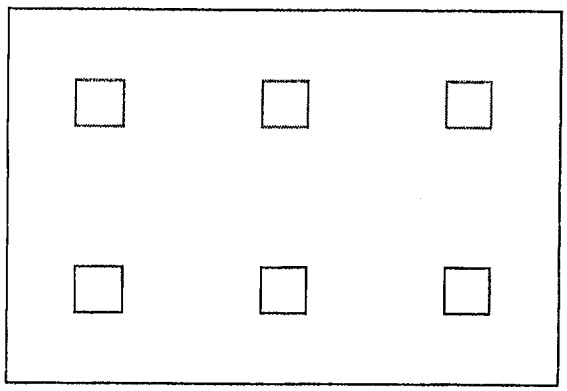

FIG. 31A

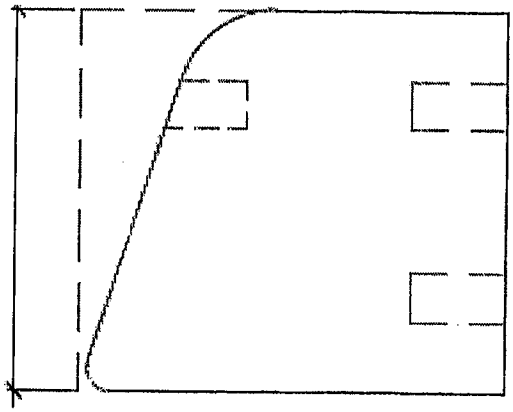

FIG. 31B

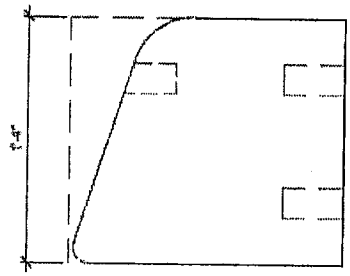

FIG. 31C

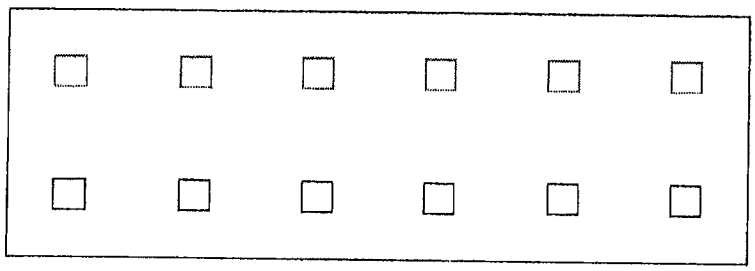

FIG. 31D

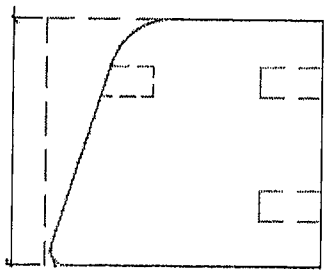

FIG. 31E

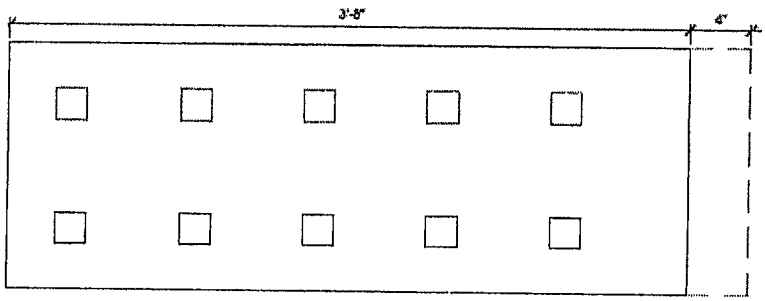

FIG. 31F

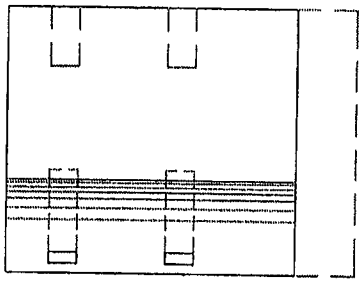

FIG. 31G

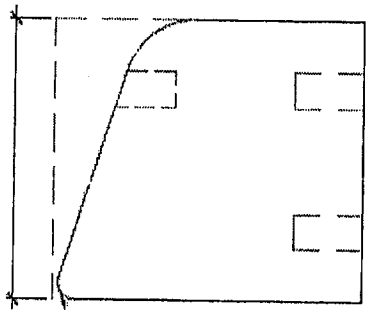

FIG. 31H

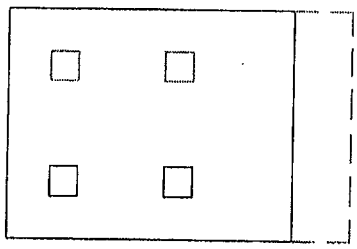

FIG. 31I

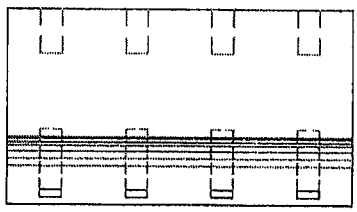

FIG. 32A

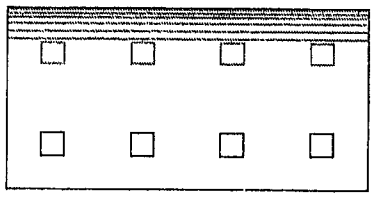

FIG. 32B

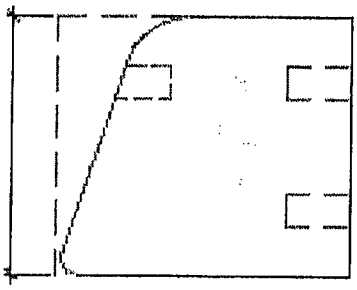

FIG. 32C

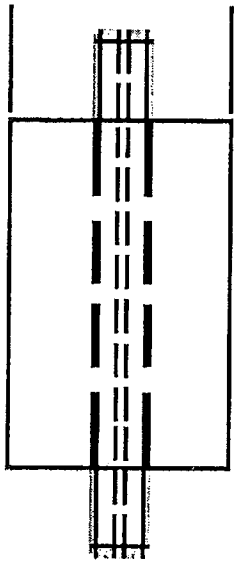

FIG. 32D

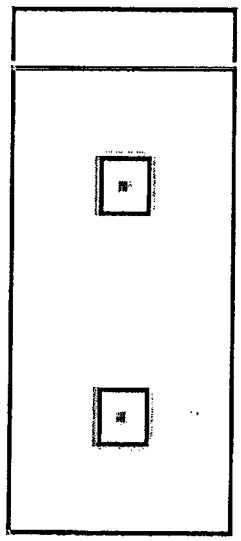

FIG. 32E

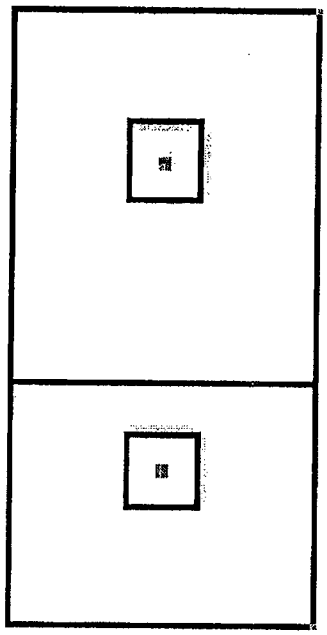

FIG. 32F

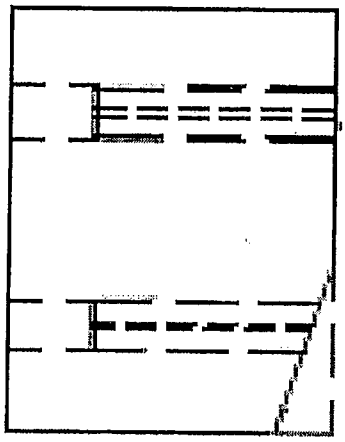

FIG. 32G

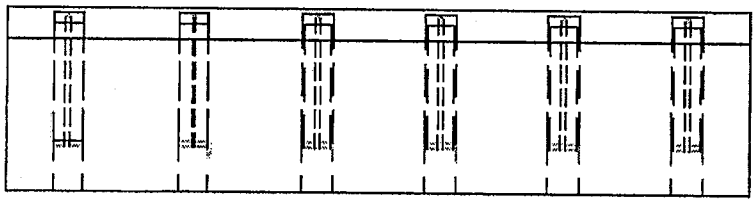

FIG. 32H

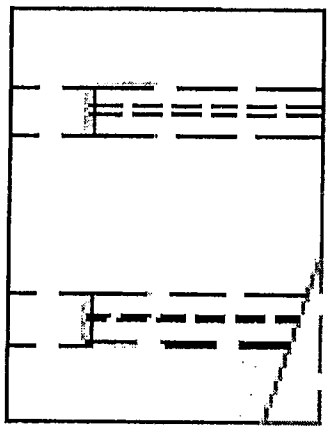

FIG. 32I

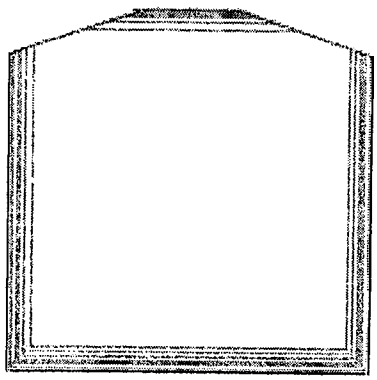

FIG. 33A

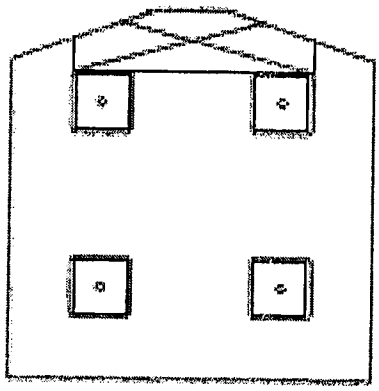

FIG. 33B

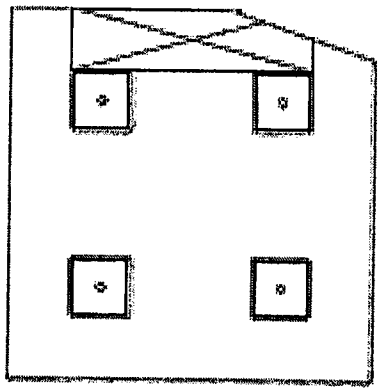

FIG. 33C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2015/000454

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***B28B 23/00*** (2006.01), ***B28B 1/52*** (2006.01), ***B28B 7/22*** (2006.01), ***B32B 3/06*** (2006.01), ***E04C 1/00*** (2006.01), ***E04C 1/39*** (2006.01)

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC (2006.01): B28B 23/00, B28B 1/52, B28B 7/22, B32B 3/06, E04C 1/00, E04C 1/39, B28B 17/00, B29C 70/00

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

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Questel-Orbit (FamPat English Full-Text Database)
Keywords: block, interlock, concrete, pin, insert, protrusion, mould, mold, coat

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/0311943 A1 (GRAN, J. et al.) 13 December 2012 (13-12-2012) * Whole document *	1-39
A	US 5,771,650 A (WILLIAMS, S. et al.) 30 June 1988 (30-06-1998) * Whole document *	1-39
A	US 2007/0271868 A1 (ABELLA, R.) 29 November 2007 (29-11-2007) * Whole document *	1-39
A	DE 10 2004 023 039 A1 (WALACH, P. et al.) 24 November 2005 (24-11-2005) * Whole document *	1-39

☐ Further documents are listed in the continuation of Box C.

☑ See patent family annex.

*	Special categories of cited documents:
"A"	document defining the general state of the art which is not considered to be of particular relevance
"E"	earlier application or patent but published on or after the international filing date
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O"	document referring to an oral disclosure, use, exhibition or other means
"P"	document published prior to the international filing date but later than the priority date claimed
"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&"	document member of the same patent family

Date of the actual completion of the international search 21 October 2015 (21-10-2015)	Date of mailing of the international search report 06 November 2015 (06-11-2015)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Authorized officer Maxime Bazinet (819) 934-8570

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2015/000454

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		CA2797192C	10 June 2014 (10-06-2014)
		CA2848741A1	11 December 2012 (11-12-2012)
		CA2848741C	18 August 2015 (18-08-2015)
		US2013219808A1	29 August 2013 (29-08-2013)
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(10-05-2013)			
US5771650A	30 June 1998 (30-06-1998)	None	
US2007271868A1	29 November 2007 (29-11-2007)	US2007271868A1	29 November 2007 (29-11-2007)
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		CN101506444B	07 September 2011 (07-09-2011)
		CO5820228A1	30 November 2007 (30-11-2007)
		CR10542A	21 April 2009 (21-04-2009)
		ECSP088995A	30 June 2009 (30-06-2009)
		EP2029826A1	04 March 2009 (04-03-2009)
		GT200800260A	29 August 2011 (29-08-2011)
		JP2009537718A	29 October 2009 (29-10-2009)
		MX2008014962A	15 April 2009 (15-04-2009)
		WO2007135478A1	29 November 2007 (29-11-2007)
DE102004023039A1	24 November 2005 (24-11-2005)	None	