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(54) **THREE-DIMENSIONAL LIGHTWEIGHT STEEL FRAMEWORK FORMED BY TWO-WAY CONTINUOUS DOUBLE BEAMS**

(57) A three-dimensional lightweight steel framework comprising a beam, a purlin and/or a stringer, a column, a wall body, a floor slab and/or a roof, and a lateral-force-resistant rod and/or tension braces. The beam is a continuous double beam comprising two identical or different continuous single beams attached at both sides of the column, the continuous single beam and the column are continuous and not interrupted at a cross joint of the continuous single beam and the column. The present invention has advantages of simple structure and low manufacturing cost.

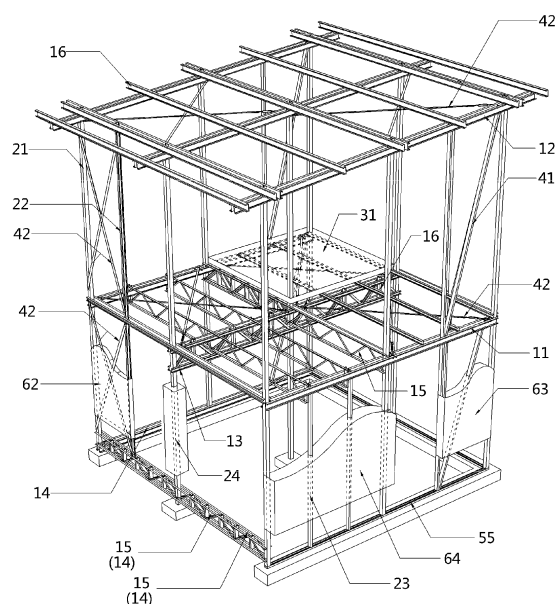


FIG. 1

Description

Cross Reference To Related Applications

[0001] This application claims the benefit of China Patent Application No. 201410035766.3 filed on Jan. 24, 2014, which is hereby incorporated by reference in its entirety.

Background of the Invention

1. Field of the Invention

[0002] The present invention relates to a lightweight steel framework, and more particularly, to a three-dimensional lightweight steel framework.

2. Description of the Prior Art

[0003] A lightweight steel structure with a lightweight steel framework has been developed rapidly and widely used in industrial buildings. Despite of high manufacturing cost of the lightweight steel structure, the lightweight steel structure still has advantages of short construction period, low energy consumption and low carbon emission, which make the lightweight steel structure more competitive than traditional concrete structure in the market. Therefore, the lightweight steel structure becomes more and more popular in low-rise residential buildings.

[0004] However, there are still some drawbacks to be improved. For example, a structural beam and a structural column of the lightweight steel structure are usually connected with each other in a butt joint (e.g., in a fixed or hinged manner). Such connection complicates an assembly process of the lightweight steel structure and results in a serious accumulative error during assembly.

[0005] In China Patent Application No. 200920171128.9 filed on August 20, 2009, it provides a lightweight steel framework without a floor slab, a roof, a reinforced lightweight composite floor slab, and a lateral-force-resistant rod. Therefore, an overall structural strength of the lightweight steel framework is insufficient. Furthermore, a cross section of a continuous double beam of the lightweight steel framework cannot be changed according to different situation, which is not flexible and wastes material. Moreover, the continuous double beams are connected to each other by a crisscross joint. Such connection results in extra space consumption and ununiformed load distribution. Furthermore, it is difficult to connect the long continuous double beams with such connection.

[0006] A column or a brace is usually secured onto an anchor bolt. The anchor bolt is positioned and embedded on site, which complicates the assembling process. In China Patent Application No. 200920158989.3 filed on Jun 30, 2009, it provides an integral positioning steel frame to overcome the aforementioned drawbacks. However, a fastener for securing the anchor bolt cannot main-

tain an upright posture and is easy to be loose because the fastener is fixed onto only one point on a bottom of the integral positioning steel frame. Furthermore, it takes much time to cure concrete before securing the anchor bolt and assembling the lightweight steel framework, which extends construction period.

[0007] A hollow structural section (HSS) is usually formed by an enclosed square-shape steel tube or two C-shaped steel members welded to each other. In practical applications, a connection hole on the enclosed square-shape steel tube is formed by drilling or flame cutting instead of punching, which increases manufacturing cost. Furthermore, a high strength fastener cannot be used for connecting the enclosed square-shape steel tube, which reduces connection strength. Moreover, in order to prevent rusting, the enclosed square-shape steel tube is required to be galvanized after machining, which also increases manufacturing cost. If two galvanized C-shaped steel members are welded to each other, a galvanized coating layer may be damaged. In China Patent Application No. 201010216616.4 filed on Jun 30, 2010, it overcomes the aforementioned drawbacks. However, a compressive strength of a square-shaped steel tube filled with concrete/cement mortar is far greater than a bearing capability calculated by a slenderness ratio of the square-shaped steel tube. In other words, the concrete/the cement mortar has no function. Furthermore, the square-shaped steel tube with the concrete/ the cement mortar cannot be arranged closely during transportation, which results in excessive transportation volume and high transportation cost.

[0008] In China Patent Application No. 201310044986.8 filed on February 4, 2013, in order to reduce a weight of a floor slab and improve performance of waterproof and fireproof of the floor slab, it reduces a thickness of the floor slab for reducing the weight of the floor slab. However, a lateral force resistance of the floor slab is reduced at the same time, which reduces a capability of the floor slab for transferring a horizontal force.

[0009] In China Patent Application No. 200920147815.7 filed on April 14, 2009, and China Patent Application No. 201310664792.8 filed on December 10, 2013, an expanded ribbed mesh cannot be engaged with the web firmly, so that a stressed-skin effect is reduced.

[0010] In China Patent Application No. 201110023291.2 filed on January 20, 2011, a positioning and supporting member cannot position a steel mesh and a wall body firmly, which allows a painted layer to be easily cracked along a longitudinal direction of the positioning and supporting member.

[0011] Therefore, there is a need to design a three-dimensional lightweight steel framework to overcome the above drawbacks.

Summary of the Invention

[0012] A main object of the present invention is to pro-

vide a three-dimensional lightweight steel framework with enhanced structural strength, so that a heavy material, such as a brick, concrete, or soil, can be adapted for the three-dimensional lightweight steel framework.

[0013] Another object of the present invention is to provide a three-dimensional lightweight steel framework with simple structure which meets the safety and environmental standards and facilitates the in-situ operation.

[0014] According to the claimed invention, a three-dimensional lightweight steel framework includes a beam, a purlin and/or a stringer, a column, a wall body, a floor slab and/or a roof, and a lateral-force-resistant rod and/or tension braces. The beam is a continuous double beam including two identical or different continuous single beams attached at both sides of the column. The continuous single beam and the column are continuous and not interrupted at a cross joint of the continuous single beam and the column. As a result, it reduces accumulative errors during the connection of the beams and simplifies a connecting process of the columns and the beams.

[0015] According to an embodiment of the present invention, the column includes a structural main column, a small column, a reinforcing column in the wall body, a brace, and a vertical column and/or a truss beam brace. The beam includes a horizontal beam, an inclined beam, an upper chord beam and/or a bottom chord beam, and/or a ground tie beam. The continuous single beam is formed by at least one of a L-shaped steel member, a U-shaped steel member, a C-shaped steel member, a Z-shaped steel member, a plate-shaped steel member, and a slice truss. The purlin or the stringer is formed by at least one of the U shaped steel member, the C-shaped steel member, the Z-shaped steel member, and the slice truss. The slice truss includes an upper chord, a bottom chord, and a shear resistance brace. The upper chord or the bottom chord is formed by the L-shaped steel member, and the shear resistance brace is formed by the L-shaped steel member, the plate-shaped steel member, or a rounded steel member. The column is formed by at least one of the C-shaped steel member, an opened square-shaped steel member, a bent square-shaped steel member, and a square-shaped steel member. The opened square-shaped steel member is filled with concrete and/or cement mortar. The bent square-shaped steel member is formed by cold rolling a steel plate. Two ends of the steel plate are bent to form two buckled edges with 90 degrees, and the two buckled edges are engaged together via rivets arranged at intervals, the continuous single beam is connected to the column by means of a bolt passing through a column connection hole on the column and a beam connection hole on a web of the continuous single beam.

[0016] According to an embodiment of the present invention, the L-shaped steel member, the U-shaped steel member, the C-shaped steel member, the Z-shaped steel member and the opened square-shaped steel member are provided with curled edges. An upper flange and a

bottom flange of the U-shaped steel member, an upper flange and a bottom flange of the C-shaped steel member, or an upper flange and a bottom flange of the Z-shaped steel member have an identical width or different widths. The L-shaped steel member, the U-shaped steel member, the C-shaped steel member, the Z-shaped steel member, the opened square-shaped steel member, the bent square-shaped steel member, and the plate-shaped steel member are formed by cutting and/or cold rolling a galvanized steel reel.

[0017] According to an embodiment of the present invention, the continuous single beam includes a plurality of single beams connected via at least one overlapped connection or at least one beam connector.

[0018] According to an embodiment of the present invention, the floor slab is a reinforced lightweight composite floor slab. The reinforced lightweight composite floor slab includes a lightweight composite floor slab. The lightweight composite floor slab, the purlin, and the lateral-force-resistant rod and/or a ceiling are connected integrally by at least one floor connector. The lightweight composite floor slab is installed over the purlin, and the lateral-force-resistant rod and/or the ceiling are built under the purlin.

[0019] According to an embodiment of the present invention, the lightweight composite floor slab includes a floor deck. The floor deck is formed by a profiled steel sheet. The profiled steel sheet is a corrugated profiled steel sheet or a folded profiled steel sheet. The profiled steel sheet is with a 0.2 to 1.0 millimeter thickness and a 30 to 50 millimeter groove depth. The profiled steel sheet is filled with concrete and/or cement mortar. The concrete and/or the cement mortar is framed by an internal anti-cracking mesh and/or anti-cracking fiber. A height difference between the concrete and/or the cement mortar and a peak of the profiled steel sheet is less than 50 millimeter. The profiled steel sheet is connected to the purlin by the floor connector. The floor connector includes a self-tapping screw, a sleeve and/or a bearing gasket. The sleeve is tightly attached to the self-tapping screw. The sleeve is made of metal or plastic. At least one side of the sleeve is expanded to form the bearing gasket. The purlin is disposed at intervals of less than 180 centimeter. At least one pair of opposite corners of the lightweight composite floor slab are bounded by the lateral-force-resistant rod. The lateral-force-resistant rod is formed by a strip steel. The strip steel is connected to the purlin by the self-tapping screw. The ceiling includes a first expanded ribbed mesh. The first expanded ribbed steel mesh includes a first V-shaped rib and a first expanded mesh surface. The first expanded ribbed steel mesh is connected to the purlin by the self-tapping screw and/or an air nail. The ceiling is filled with the cement mortar, and the cement mortar is framed by the internal anti-cracking mesh and/or the anti-cracking fiber.

[0020] According to an embodiment of the present invention, the continuous single beam is an embedded continuous single beam. An upper flange and a bottom

flange of the embedded continuous single beam formed by the L-shaped steel member, the C-shaped steel member or the Z-shaped steel member and corresponding to the column are cut off, so that the column is embedded into the embedded continuous single beam at a cross joint of the column and the embedded continuous single beam. The embedded continuous single beam is connected to the column by means of the bolt passing through the column connection hole on the column and the beam connection hole on a web of the embedded continuous beam.

[0021] According to an embodiment of the present invention, the three-dimensional lightweight steel framework further includes a reinforced structure.

[0022] According to an embodiment of the present invention, the bottom chord beam is formed by the opened square-shaped steel member with an upward opening. A part of the opened square-shaped steel member overlapping the column or the brace is cut off. The opened square-shaped steel member is connected to the column or the brace by means of the bolt passing through the beam connection hole on a web of the opened square-shaped steel member and the column connection hole on the column or the brace, so as to form the reinforced structure.

[0023] According to an embodiment of the present invention, the reinforced structure is a positioning hole arranged at an intersection of centerlines of the beam and the column, and the positioning hole is for falsely fixing the beam and the column by means of the bolt or a conical steel bar.

[0024] According to an embodiment of the present invention, a space between two continuous single beams, and/or a cavity between the columns, and/or a cavity of the opened square-shaped steel member of the bottom chord beam is filled with the concrete and/or the cement mortar, so as to form the reinforced structure.

[0025] According to an embodiment of the present invention, the reinforced structure is a plurality of self-tapping screw disposed at a periphery of the bolt and for falsely fixing the beam and the column after the beam and the column are calibrated, and the plurality of self-tapping screw is removed after the cavity between the columns or the opened square-shaped steel member of the bottom chord beam is filled with the concrete and/or the cement mortar.

[0026] According to an embodiment of the present invention, a supporting steel member is arranged in the space between the two continuous single beams, and/or in the cavity between the columns or the opened square-shaped steel member forming the bottom chord beam, where the concrete cement and/or the cement mortar is filled, so as to form the reinforced structure, and the supporting steel member is a steel bar, a stirrup, or a pre-stressed steel wire.

[0027] According to an embodiment of the present invention, the stirrup is a square stirrup, a rounded stirrup, a helical stirrup or a rounded steel mesh, and the pre-

stressed steel wire is provided with a sleeve.

[0028] According to an embodiment of the present invention, the steel bar, the sleeve and the pre-stressed steel wire pass through the column.

5 **[0029]** According to an embodiment of the present invention, the reinforced structure member is a thickened steel sheet surrounding the beam connection hole on the beam or the column connection hole on the column, and the thickened steel sheet is connected to the beam or 10 the column by means of a rivet, and/or a riveting clinching joint, and/or by welding.

[0030] According to an embodiment of the present invention, the reinforced structure is a punching groove surrounding the connection hole of the beam. The punching groove is embedded into the column connection hole 15 on the column, and a diameter of the column connection hole on the column is greater than a width of the punching groove.

[0031] According to an embodiment of the present invention, the reinforced structure is an additional exterior member attached on an outer side of the beam. The additional exterior member is formed by the L-shaped steel member, the U-shaped steel member, the C-shaped steel member, the plate-shaped steel member, the 20 square-shaped steel member, or a square-shaped wooden member.

[0032] According to an embodiment of the present invention, a thermal insulating gasket is arranged between the beam and the additional exterior member.

30 **[0033]** According to an embodiment of the present invention, the column is surrounded by a spot-welded steel mesh, a woven steel mesh, or an expanded steel mesh and connected to the wall by the cement mortar, so as to form the reinforced structure.

35 **[0034]** According to an embodiment of the present invention, the reinforced structure is an integrally-positioned steel frame. The integrally-positioned steel frame includes an angular connector, a bolt-reinforced gasket, a frame body, an embedded bolt, and an anti-pulling nut. 40 The embedded bolt is connected to a base of the column via the angular connector. The frame body is formed by the C-shaped steel member having an upward opening, an embedded hole and curled edges at ends of the upward opening. The reinforced gasket is arranged above the embedded hole and provided with a positioning hole. 45 The C-shaped steel member is filled with the concrete after the embedded bolt is fixed, and the base of the column is arranged on the integrally-positioned steel frame.

50 **[0035]** According to an embodiment of the present invention, the embedded bolt is screwed with the anti-pulling nut below the bolt-reinforced gasket or the embedded hole of the C-shaped steel member.

[0036] According to an embodiment of the present invention, the reinforced structure is a reinforcing member attached to an outer side of the structural main column. The reinforcing member includes steel columns and/or reinforced concrete columns surrounding the structural

main column. The steel columns and/or the reinforced concrete columns are continuous or interrupted at the cross joint of the beam and the column, and the concrete or the cement mortar is filled between a space between the steel columns and the structural main column.

[0037] According to an embodiment of the present invention, the reinforced structure is a precast concrete wall slab and/or a precast lightweight concrete wall slab and/or a precast hollow concrete wall slab installed between the two continuous double beams.

[0038] According to an embodiment of the present invention, the reinforced structure is a composite wall body installed between the columns. The composite wall body includes a composite wall surface. The composite wall surface comprises a second expanded ribbed mesh, a cement mortar layer, a fastener, and a stressed-skin structure. The composite wall surface is attached to at least one side of the column, when the composite wall surface is attached on only one side of the column, the lateral-force-resistant rod is arranged at the other side of the column.

[0039] According to an embodiment of the present invention, the second expanded ribbed mesh includes a second V-shaped rib and a second expanded mesh surface. The second expanded ribbed mesh is fixed onto the column by the fastener. The fastener is a self-tapping screw or an air nail, and the lateral-force-resistant rod is formed by a strip steel.

[0040] According to an embodiment of the present invention, the composite wall body further includes a reinforcing member. The reinforcing member includes a fixation gasket and an anti-cracking member. The fixation gasket is tightly attached to a groove of the second V-shaped rib for seating the air nail. The fixation gasket is made of hard plastic, and the anti-cracking member is a fiberglass mesh or a spot-welded metal mesh, or fiber in the concrete or the cement mortar.

[0041] According to an embodiment of the present invention, the reinforced structure is a composite wall body installed between the columns. The composite wall body encloses the structural main column, the small column and/or the reinforcing column in the wall body, and the brace installed between the beam and the column. The composite wall body includes two second expanded ribbed meshes, at least one tying member, an insulating layer, and a supporting member. The two second expanded ribbed meshes are fastened onto two sides of the structural main column, the small column and the reinforcing column by at least one fastener. The at least one fastener is a self-tapping screw or an air nail. The wall body is disposed between the second expanded ribbed meshes. The insulating layer is installed between the second expanded ribbed meshes. The second expanded ribbed mesh includes a second V-shaped rib and a second expanded mesh surface. The supporting member is situated at an outer side of the second V-shaped rib. The tying member is a steel wire or plastic wire. The tying member ties to the second V-shaped rib of the sec-

ond expanded ribbed mesh and/or the supporting member vertically disposed on the second V-shaped ribs of the second expanded ribbed mesh, and the wall body is filled with building waste residue, soil, grass, concrete or lightweight concrete.

[0042] According to an embodiment of the present invention, the reinforced structure is a lateral-force-resistant rod arranged at a side of the column. The lateral-force-resistant rod is made of the strip steel. An upper end of the lateral-force-resistant rod is provided with a rod connection hole and connected to the column by the bolt passing through the rod connection hole on the lateral-force-resistant rod and the column connection hole on the column, and a lower end of the lateral-force-resistant rod is provided with a tensioning hole and curled by 90 degrees, so as to be fixed onto the side of the column by the self-tapping screws.

[0043] According to an embodiment of the present invention, the ground tie beam includes two identical continuous single beams. The continuous single beam is formed by the slice truss. The slice truss includes the upper chord, the bottom chord and the shearing-resistant brace. The upper chord and/or the bottom chord are formed by the L-shaped steel member, and the shearing-resistant brace is formed by the L-shaped steel member and/or the plate-shaped steel member and/or the rounded steel member.

[0044] In summary, the three-dimensional lightweight steel framework has advantages of simple structure and low manufacturing cost. The three-dimensional lightweight steel framework can be secured by bolts, which allows non-professional workers to participate in construction period. The column is sandwiched between the two single beams, so that the column and the beam can be assembled simultaneously, which is flexible in replacement and assembly. The steel member is preferably formed by cutting or cold rolling a galvanized steel reel, which facilitates automated production. During the production and the in-situ assembly, no welding process is required, so it prevents a galvanized layer from being damaged. The reinforced strength of the three-dimensional lightweight steel framework makes a traditional slurry-type wall body made of heavy materials, such as bricks, concretes and soils, and the recycled materials, be used cooperatively. Furthermore, by disposing two continuous single beams on both sides of the column, it reduces accumulative error during assembly.

[0045] These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

Brief Description of the Drawings

[0046]

FIG. 1 is a schematic diagram of a three-dimensional

lightweight steel framework according to an embodiment of the present invention.

FIG. 2 illustrates diagrams of cross sections of a beam and a column and reinforced structures of the beam and the column according to an embodiment of the present invention.

FIG. 3 illustrates diagrams of a continuous single beam according to an embodiment of the present invention.

FIG. 4 illustrates diagrams of a reinforced lightweight composite floor slab 31 according to an embodiment of the present invention.

FIG. 5 illustrates diagrams of an embedded continuous single beam and a reinforced structure of a lateral-force-resistant rod according to an embodiment of the present invention.

FIG. 6 illustrates diagrams of a slice truss 15 according to an embodiment of the present invention.

FIG. 7 illustrates diagrams of a truss beam 13 according to an embodiment of the present invention.

FIG. 8 illustrates diagrams of a reinforced structure of a punching groove 71 and a thickened steel sheet 518 according to an embodiment of the present invention.

FIG. 9 illustrates diagrams of reinforced structures of the three-dimensional lightweight steel framework according to an embodiment of the present invention.

FIG. 10 illustrates diagrams of an integrally-positioned steel frame 55 according to an embodiment of the present invention.

FIG. 11 illustrates diagrams of a composite wall body 62 with two stressed-skin structures according to an embodiment of the present invention.

FIG. 12 illustrates diagrams of a fixation gasket of the composite wall body 517 with the two stressed-skin structures according to an embodiment of the present invention.

FIG. 13 illustrates diagrams of a composite wall body 64 with the second expanded ribbed meshes according to an embodiment of the present invention.

FIG. 14 illustrates diagrams of a reinforcing member 24 according to an embodiment of the present invention.

[0047] The denotations in the specification and the figures are used for purposes of illustration and in no way limiting. In embodiments of the present invention, the numerals and components are referred as follows:

1: beam
11: horizontal beam
12: oblique beam
13: truss beam
131: upper chord beam
132: bottom chord beam
134: truss beam brace
14: ground tie beam

15: slice truss
151: upper chord
152: bottom chord
153: shear resistance brace
16: purlin / stringer
1/L: L-shaped steel member
1/U: U-shaped steel member
1/C: C-shaped steel member
1/Z: Z-shaped steel member
1/P: plate-shaped steel member
1/W: square-shaped wooded member
2: column
21: main column
22: small column
23: reinforcing column
24: a reinforcing member
213: vertical column
214: steel column
215: concrete Column
2/U: U-shaped steel member
2/C: C-shaped steel member
2/RO: opened square-shaped steel member
2/RC: bent square-shaped steel member
3: floor slab
25 31: reinforced lightweight composite floor slab
311 lightweight composite floor slab
32: ceiling
41: brace
42: lateral-force-resistant rod
30 501: bolt
502: self-tapping screw
503: thermal insulating gasket
505: round steel
506: stirrup
35 507: pre-stressed steel wire
508: sleeve
509: tensioning bolt
510: rivet
511: additional exterior member
40 512: connector
513: sleeve
5131: expanded sleeve
514: bearing gasket
515: air nail
45 516: steel bar
517: fixation gasket
518: thickened steel sheet
51: floor connector
52: profiled steel sheet
50 53: steel mesh
531: anti-cracking fiber
54: first expanded ribbed steel mesh
541: first V-shaped rib
55: integrally-positioned steel member
551: frame body
552: bolt-reinforced gasket
553: embedded bolt
554: angular connector

555: anti-pulling nut
 60: concrete
 601: concrete /cement mortar
 61: cement mortar layer
 62: composite wall body
 621: composite wall surfaces
 63: wall body
 64: composite wall body
 65: insulating layer
 66: filled wall body
 67: tying member
 68: precast concrete wall slab
 70: beam connection hole
 71: punching groove
 72: tensioning hole

Detailed Description

[0048] In order to make the objects, the technical solutions and the advantages of the present invention more apparent, the present invention will be described hereinafter in conjunction with the drawings and embodiments.

[0049] Please refer to FIG. 1. FIG. 1 is a schematic diagram of a three-dimensional lightweight steel framework according to an embodiment of the present invention. The three-dimensional lightweight steel framework includes an oblique beam 12 on a roof, a horizontal beam 11, a ground tie beam 14, a slice truss 15, a truss beam 13, a purlin/stringer 16, an integrally-positioned steel member 55, a structural main column 21, a small column 22, a reinforcing column 23, a reinforcing member 24 arranged at an outer side of the structural main column 21, a brace 41, a lateral-force-resistant rod 42, a composite wall body 62 with a stressed-skin structure, a wall body 63 with blocks, another composite wall body 64 with an expanded ribbed steel mesh, and a reinforced lightweight composite floor slab 31. Each of the oblique beam 12, the horizontal beam 11, and the ground tie beam 14 is a continuous double beam including two continuous single beams 1. Each of the structural main column 21, the small column 22, and the reinforcing column 23 is a column 2. The reinforcing column 23 is disposed in the wall body 63 or the composite wall bodies 62, 64.

[0050] FIG. 2 illustrates diagrams of cross sections of the beam 1 and the column 2 and reinforced structures of the beam 1 and the column 2 according to an embodiment of the present invention. Please refer FIG. 2-1 to FIG. 2-3. FIG. 2-1 is a sectional diagram of the continuous single beam 1 according to an embodiment of the present invention. FIG. 2-2 is a sectional diagram of the column 2 according to an embodiment of the present invention. FIG. 2-3 is a diagram of a reinforced structure of the beam 1 and the column 2 according to an embodiment of the present invention. As shown in FIG. 2-1, the beam 1 can be formed by an L-shaped steel member 1/L, a U-shaped steel member, a C-shaped steel member, a Z-shaped steel member, a plate-shaped steel 1/P, a square-

shaped wooded member 1/W, or the slice truss 15. Furthermore, the L-shaped steel member, the U-shaped steel member, the C-shaped steel member, or the Z-shaped steel member can be provided with curled edges.

5 An upper flange and a bottom flange of the U-shaped steel member 1/U, an upper flange and a bottom flange of the C-shaped steel member 1/C, or an upper flange and a bottom flange of the Z-shaped steel member 1/Z have an identical width or different widths. As shown in
 10 FIG. 2-2, the column 2 can be formed by a U-shaped steel member 2/U, a C-shaped steel member 2/C, an opened square-shaped steel member 2/RO, or a bent square-shaped steel member 2/RC. The bent square-shaped steel member 2/RC has two buckled edges engaged together via rivets 510 arranged at intervals. As
 15 shown in FIG. 2-3, the reinforced structure of the continuous single beam 1 and the column 2 is formed by filling a concrete /cement mortar 601 in the column 2 and the beam 1.

20 **[0051]** FIG. 3 illustrates diagrams of the continuous single beam 1 according to an embodiment of the present invention. Please refer to FIG. 3-1. FIG. 3-1 is a diagram of the two continuous single beams 1 connected via an overlapped connection according to an embodiment of
 25 the present invention. As shown in FIG. 3-1, each continuous single beam 1 is provided with a beam connection hole 70 at an end of each continuous single beam 1. Two upper flanges and two bottom flanges of the two continuous single beams 1 overlapped are cut off, so that the
 30 two continuous single beams 1 are connected to the column by means of a bolt 510 passing through the two beam connection holes 70 and a column connection hole. Please refer to FIG. 3-2. FIG. 3-2 is a diagram of the two slice trusses 15 connected to via an overlapped connection according to an embodiment of the present invention.
 35 As shown in FIG. 3-2, the two slice trusses 15 are connected to the column 2. An upper chord 151 of each slice truss 15 is formed by the L-shaped steel member 1/L, and a bottom chord 152 is formed by the L-shaped steel member 1/L. An end of each of the two slice trusses 15 is provided with a truss connection hole. A contact surface of the column 2 is provided with a column connection hole. The two slice truss 15 are overlapped and connected to the contact surface of the column 2 by means of
 40 the bolt 501. Please refer to FIG. 3-3. FIG. 3-3 is a diagram of the two continuous single beams 1 connected via a connector according to an embodiment of the present invention. As shown in FIG. 3-3, an end of each continuous single beam 1 is provided with the beam connection hole 70. The connector 512 is provided with a plurality of connector connection holes and connected to the two continuous single beams 1 and the column 2 by means of bolts 501. The connector 512 is formed by the U-shaped steel member 1/U, the L-shaped steel member
 45 1/L, or the plate-shaped steel member 1/P.

[0052] FIG. 4 illustrates diagrams of the reinforced lightweight composite floor slab 31 according to an embodiment of the present invention. Please refer to FIG.

4-1. FIG. 4-1 is a perspective diagram of the reinforced lightweight composite floor slab 31 according to an embodiment of the present invention. As shown in FIG. 4-1, the reinforced lightweight composite floor slab 31 includes a lightweight composite floor slab 311. The lightweight composite floor slab 311, the purlin 16, the lateral-force-resistant rod 42 and/or a ceiling 32 are connected integrally by at least one floor connector 51. Please refer to FIG. 4-2 to FIG. 4-5. FIG. 4-2 is a diagram of the lightweight composite floor slab 311 according to an embodiment of the present invention. FIG. 4-3 is a diagram of the floor connector 51 according to an embodiment of the present invention. FIG. 4-4 and FIG. 4-5 are diagrams of the profiled steel sheet according to an embodiment of the present invention. As shown in FIG. 4-2, the lightweight composite floor slab 311 includes a floor deck. The floor deck is formed by a profiled steel sheet 52. The profiled steel sheet 52 is connected to the purlin 16 by the floor connector 51, and the profiled steel sheet 52 is filled with the concrete and/or the cement mortar 601. The concrete and/or the cement mortar 601 is framed by an internal anti-cracking mesh and/or anti-cracking fiber 531. As shown in FIG. 4-3, the floor connector 51 includes a self-tapping screw 502, a sleeve 513 and/or a bearing gasket 514, and the sleeve 513 is tightly attached to the self-tapping screw 502. The sleeve 513 can be an expanded sleeve 5131. At least one side of the expanded sleeve 5131 is expanded to form the bearing gasket 514. As shown in FIG. 4-4 and FIG. 4-5, the profiled steel sheet 52 can be a corrugated profiled steel sheet, as shown in FIG. 4-5, or a folded profiled steel sheet, as shown in FIG. 4-4. Please refer to FIG. 4-6 and FIG. 4-7. FIG. 4-6 is a diagram of a first expanded ribbed steel mesh 54 according to an embodiment of the present invention. FIG. 4-7 is a sectional diagram of the first expanded ribbed steel mesh 54 according to an embodiment of the present invention. As shown in FIG. 4-6, the ceiling 32 includes the first expanded ribbed steel mesh 54. The first expanded ribbed steel mesh 54 includes a first V-shaped rib 541 and an expanded mesh surface. Please refer to FIG. 4-8 and FIG. 4-9. FIG. 4-8 is a diagram of the reinforced lightweight composite floor slab 31 and the lateral-force-resistant rod 42 connected to the purlin 16 according to an embodiment of the present invention. FIG. 4-9 is a diagram of the lightweight composite floor slab 311 and the ceiling 32 connected to the purlin 16 according to an embodiment of the present invention. As shown in FIG. 4-8 and FIG. 4-9, the lateral-force-resistant rod 42 is arranged below the purlin 16, and the lightweight composite floor slab 311 is arranged above the purlin 16. The purlin 16 is connected to the lateral-force-resistant rod 42 by the self-tapping screw 502 or an air nail 515. The lightweight composite floor slab 311 is arranged above the purlin 16. The ceiling 32 is filled with cement mortar 601, and the cement mortar 601 is framed by the internal anti-cracking mesh and/or the anti-cracking fiber 531. The purlin 16 is connected to the ceiling 32 by means of the self-tapping screw 502 or the

air nail 515. The lightweight composite floor slab 311 is arranged above the purlin 16.

[0053] FIG. 5 illustrates diagrams of an embedded continuous single beam 17 and a reinforced structure of a lateral-force-resistant rod 42 according to an embodiment of the present invention. Please refer to FIG. 5-1. FIG. 5-1 is a diagram of the embedded continuous single beam 17 according to an embodiment of the present invention. As shown in FIG. 5-1, the embedded continuous single beam 17 can be formed by the L-shaped steel member 1/L, the C-shaped steel member 1/C, or the Z-shaped steel member 1/Z. An upper flange and a bottom flange of the embedded continuous single beam 17 corresponding to the column 2 are cut off, so that the column 2 is embedded into the embedded continuous single beam 17 at a cross joint of the column 2 and the embedded continuous single beam 17. The embedded continuous single beam 17 is provided with the beam connection hole 70 at a web of the embedded continuous single beam 1, and connected to the column 2 by means of the bolt 501. Please refer to FIG. 5-2. FIG. 5-2 is a diagram of a reinforced structure according to an embodiment of the present invention. The reinforced structure is the lateral-force-resistant rod 42. The lateral-force-resistant rod 42 is provided with a rod connection hole on an upper end of the lateral-force-resistant rod 42, and connected to the column 2 by means of the bolt 501 for tensing the lateral-force-resistant rod 42. In addition, the lateral-force-resistant rod 42 is provided with a tensioning hole 72 at a lower end of the lateral-force-resistant rod 42 for tensing the lateral-force-resistant rod 42. After the lateral-force-resistant rod 42 is tensed and positioned, the lateral-force-resistant rod 42 is falsely fixed to one side of the column 2 by means of the self-tapping screw 502. In this embodiment, the lateral-force-resistant rod 42 is a curled rod, and the lower end of the lateral-force-resistant rod 42 is curled by 90 degrees, so as to be fixed onto the side of the column 2 by the self-tapping screw 502.

[0054] FIG. 6 illustrates diagrams of the slice truss 15 according to an embodiment of the present invention. Please refer to FIG. 6-1 to FIG. 6-5. FIG. 6-1 is a diagram of the slice truss 15 according to an embodiment of the present invention. FIG. 6-2 is a top view diagram of the slice truss 15 according to an embodiment of the present invention. FIG. 6-3 is a sectional diagram of the slice truss 15 shown in FIG. 6-1 according to an embodiment of the present invention. FIG. 6-4 is a sectional diagram of the slice truss 15 shown in FIG. 6-1 according to an embodiment of the present invention. FIG. 6-5 is a perspective diagram of the slice truss 15 of the embodiment of the present invention. As shown in FIG. 6-1 to FIG. 6-5, the slice truss 15 includes an upper chord 151, a bottom chord 152, and a shear resistance brace 153. The upper chord 151 and/or the bottom chord 152 are formed by the L-shaped steel member 1/L, and the shear resistance brace 153 is formed by the L-shaped steel member 1/L and/or the plate-shaped steel member 1/P and/or a rounded steel member. The slice truss 15 is provided

with the beam connection holes 70 on surfaces of the upper chord 151 and the bottom chord 152 contacting with the column 2 and a vertical column 213. The slice truss 15 is connected to the column 2 and the vertical column 213 by means of the bolts 510. The two slice trusses 15 are arranged at both sides of the column 2, and connected to the column 2 at the joint by the bolts 501, without interruption. As shown in FIG. 6-3, the two slice trusses 15 are connected to each other via an overlapped connection, so as to form a continuous slice truss. The continuous slice truss intersects the two continuous single beams 1. As shown in FIG. 6-4, the upper chord 151 and the bottom chord 152 of the slice truss 15 are connected to the vertical column 213 by means of the bolt 501.

[0055] FIG. 7 illustrates diagrams of the truss beam 13 according to an embodiment of the present invention. Please refer to FIG. 7-1 to FIG. 7-2. FIG. 7-1 is a perspective diagram of the truss beam 13 according to an embodiment of the present invention. FIG. 7-2 is a diagram of the truss beam 13 according to an embodiment of the present invention. The truss beam 13 includes an upper chord beam 131, a bottom chord beam 132, and a truss beam brace 134. Each of the upper chord beam 131 and the bottom chord beam 132 is the continuous double beam. The continuous double beam can include two identical or two different continuous single beams 1. The continuous single beams 1 of the upper chord beam 131 and the bottom chord beam 132 are arranged at both sides of the column 2. The upper chord beam 131 and the bottom chord beam 132 are connected to the column 2, the vertical column 213, and the truss beam brace 134 by means of the bolts 501. Please refer to FIG. 7-3. FIG. 7-3 is a sectional diagram of the truss beam 13 shown in FIG. 7-2 according to an embodiment of the present invention. As shown in FIG. 7-3, a cavity between the two continuous single beams 1 of the upper chord beam 131, a cavity between the two continuous single beams 1 of the bottom chord beam 132, a cavity of the vertical column 213 and a cavity of the truss beam brace 134 are filled with the concrete/the cement mortar 601, so as to form a reinforced structure of the truss beam 13. Please refer to FIG. 7-4. FIG. 7-4 is a diagram of a reinforced structure according to an embodiment of the present invention. As shown in FIG. 7-4, a supporting steel member can be arranged in the space between the two continuous single beams 1, and the concrete/cement mortar 601 is filled in the space between the two continuous single beams 1, so as to form the reinforced structure. The supporting steel member can be a steel bar 501, a stirrup 506, a pre-stressed steel wire 507, or a sleeve 508 of the pre-stressed steel wire 507.

[0056] FIG. 8 illustrates diagrams of a reinforced structure of a punching groove 71 and a thickened steel sheet 518 according to an embodiment of the present invention. Please refer to FIG. 8-1. FIG. 8-1 is a diagram of two reinforced structures according to an embodiment of the present invention. One of the two reinforced structures

is the thickened steel sheet 518, and the other one is the punching groove 71. The thickened steel sheet 518 and the punching groove 71 can be arranged around the beam connection hole 70 of the continuous single beam 1 or the column connection hole of the column 2, i.e., the thickened steel sheet 518 and the punching groove 71 are located near the joint of the continuous single beam 1 and the column 2. A plurality of self-tapping screw 502 is disposed at a periphery of the bolt 501 and for falsely fixing the continuous single beam 1 and the column 2. Please refer to FIG. 8-2 and FIG. 8-3. FIG. 8-2 is a sectional diagram of the punching groove 71 shown in FIG. 8-1 according to an embodiment of the present invention. FIG. 8-3 is an enlarged diagram of FIG. 8-2 according to an embodiment of the present invention. The punching groove 71 of the continuous single beam 1 is embedded into the column connection hole 73 of the column 2, so that the continuous single beam 1 and the column 2 are connected by means of the bolt 501. The concrete/cement mortar 601 is filled in the cavity of the column 2. A diameter of the column connection hole 73 is greater than a width of the punching groove 71. Please refer to FIG. 8-4. FIG. 8-4 is a sectional diagram of the thickened steel sheet 518 according to an embodiment of the present invention. FIG. 8-5 is a sectional diagram of the thickened steel sheet 518 shown in FIG. 8-4 according to an embodiment of the present invention. As shown in FIG. 8-4 and FIG. 8-5, the thickened steel sheet 518 is an additional steel member connected to the continuous single beam 1 or the column 2 by means of a rivet, and/or a riveting clinching joint, and/or by welding.

[0057] FIG. 9 illustrates diagrams of reinforced structures of the three-dimensional lightweight steel framework according to an embodiment of the present invention. Please refer to FIG. 9-1. FIG. 9-1 is a diagram of four reinforced structures according to an embodiment of the present invention. One of the four reinforced structures is formed by filling the space between the two continuous single beams 1 with the concrete/cement mortar 601. Another one of the four reinforced structures is a precast concrete wall slab 68 arranged between the two continuous single beams 1. Another one of the four reinforced structures is formed by the column 2 surrounded by the steel mesh 54 and connected to the wall body 63 with blocks by the cement mortar 601. The other one of the fourth reinforced structures is an additional exterior member 511 arranged outside the single beam 1. Please refer to FIG. 9-2. FIG. 9-2 is a sectional diagram of the two continuous single beams 1 shown in FIG. 9-1 according to an embodiment of the present invention. As shown in FIG. 9-2, the continuous single beams 1 are filled with the concrete/cement mortar 601. Please refer to FIG. 9-3 and FIG. 9-4. FIG. 9-3 is a sectional diagram of the additional exterior member 511 shown in FIG. 9-1 according to an embodiment of the present invention. FIG. 9-4 is a sectional diagram of the additional exterior member 511 shown in FIG. 9-1 according to an embodiment of the present invention. As shown in FIG. 9-1, FIG.

9-3, and FIG. 9-4, the additional exterior member 511 is arranged at an outer side of the continuous single beam 1. The additional exterior member 511 is arranged outside the beam 1, and a thermal insulating gasket 503 is arranged between the single beam 1 and the additional exterior member 511. Please refer to FIG. 9-5. FIG. 9-5 is a sectional diagram of the column 2 shown in FIG. 9-1 according to an embodiment of the present invention. As shown in FIG. 9-5, the column 2 is surrounded by the steel mesh 53, a woven steel wire mesh, or an expanded steel wire mesh. The column 2 is connected to the wall body 63 with blocks by means of cement mortar layer 61. Please refer to FIG. 9-6. FIG. 9-6 is a sectional diagram of the precast concrete wall slab 68 shown in FIG. 9-1 according to an embodiment of the present invention. The precast concrete wall slab 68 is arranged between the two continuous single beams 1. In other embodiments, the precast concrete wall slab 68 can be replaced by a precast lightweight concrete wall slab or a precast hollow concrete wall slab.

[0058] FIG. 10 illustrates diagrams of an integrally-positioned steel frame 55 according to an embodiment of the present invention. Please refer to FIG. 10-1 to FIG. 10-2. FIG. 10-1 is a diagram of the integrally-positioned steel frame 55 according to an embodiment of the present invention. FIG. 10-2 is an exploded diagram of the integrally-positioned steel frame 55 according to an embodiment of the present invention. As shown in FIG. 10-1 and FIG. 10-2, the integrally-positioned steel frame 55 includes an angular connector 554, a bolt-reinforced gasket 552, a frame body 551, an embedded bolt 553, and an anti-pulling nut 555. The frame body 551 is formed by the C-shaped steel member 1/C. The column 2 is connected to the angular connector 554 by means of the bolts 501. The angular connector 554 is connected to the embedded bolt 553, and the bolt-reinforced gasket 552 is fixed to the frame body 551 by means of the embedded bolt 553. Please refer to FIG. 10-3 to FIG. 10-5. FIG. 10-3 is a sectional diagram of the frame body 551 according to an embodiment of the present invention. FIG. 10-4 is a sectional diagram of the bolt-reinforced gasket 552 according to an embodiment of the present invention. FIG. 10-5 is a sectional diagram of the anti-pulling nut 555 according to an embodiment of the present invention. The frame body 551 is provided with an embedded hole 72. The bolt-reinforced gasket 552 is provided with a positioning hole 74. The bolt-reinforced gasket 552 is arranged on the frame body 551, and the anti-pulling nut 555 is arranged below the bolt-reinforced gasket 552 or below the frame body 551.

[0059] FIG. 11 illustrates diagrams of the composite wall body 62 with two stressed-skin structures according to an embodiment of the present invention. Please refer to FIG. 11-1 to FIG. 11-3. FIG. 11-1 is a diagram of the composite wall body 62 with two stressed-skin structures according to an embodiment of the present invention. FIG. 11-2 is an enlarged diagram of FIG. 11-1 according to an embodiment of the present invention. FIG. 11-3 is

an enlarged diagram of in FIG. 11-1 according to an embodiment of the present invention. The composite wall body 62 includes a filled wall body 66 and two composite wall surfaces 621 arranged at two sides of the structural main column 21, the small column 22, and the reinforcing column 23. The composite wall body 62 encloses the structural main column 21, the small column 22, and the reinforcing column 23. Each of the composite wall surfaces 621 includes a stressed-skin structure. The composite wall surface 621 further includes a second expanded ribbed steel mesh 56, the cement mortar layer 61, the anti-cracking mesh and/or anti-cracking fiber 531, the self-tapping screw 502 and/or the air nail 515. Please refer to FIG. 11-4 to FIG. 11-6. FIG. 11-4 is a diagram of the composite wall body 62 with one stressed-skin structure according to an embodiment of the present invention. FIG. 11-5 is an enlarged diagram of FIG. 11-3 according to an embodiment of the present invention. FIG. 11-6 is an enlarged diagram of FIG. 11-3 according to an embodiment of the present invention. The composite wall body 62 includes the filled wall body 66, an insulating layer 65, and one composite wall surface 621 arranged at one side of the structural main column 21, the small column 22, and the reinforcing column 23. The lateral-force-resistant rod 42 is arranged at the other side of the structural main column 21, the small column 22, and the reinforcing column 23.

[0060] FIG. 12 illustrates diagrams of a fixation gasket 517 of the composite wall body 62 with the two stressed-skin structures according to an embodiment of the present invention. Please refer to FIG. 12-1 and FIG. 12-2. FIG. 12-1 is a diagram of the composite wall body 62 with the two stressed-skin structures according to an embodiment of the present invention. FIG. 12-2 is an enlarged diagram of FIG. 12-1 according to an embodiment of the present invention. In this embodiment, the composite wall body 62 further includes the fixation gasket 517. The fixation gasket 517 is tightly attached to a groove of the second V-shaped rib 541 for seating the air nail 515, and the fixation gasket 517 is made of hard plastic.

[0061] FIG. 13 illustrates diagrams of the composite wall body 64 with the second expanded ribbed meshes 56 according to an embodiment of the present invention. Please refer to FIG. 13-1 to FIG. 13-3. FIG. 13-1 is a diagram of the composite wall body 64 with the second expanded ribbed steel meshes 56 according to an embodiment of the present invention. FIG. 13-2 is a perspective diagram of the composite wall body 64 with the second expanded ribbed meshes 56 according to an embodiment of the present invention. FIG. 13-3 is a sectional diagram of the composite wall body 64 with the second expanded ribbed meshes 56 according to an embodiment of the present invention. The composite wall body 64 encloses the structural main column 21, the small column 22 and/or the reinforcing column 23. The composite wall body 64 includes two second expanded ribbed meshes 56, at least one tying member 67, the cement

mortar layer 61, and the filled wall body 66.

[0062] FIG. 14 illustrates diagrams of the reinforcing member 24 according to an embodiment of the present invention. Please refer to FIG. 14-1. FIG. 14-1 is a diagram of a reinforced structure according to an embodiment of the present invention. The reinforced structure 24 is the reinforcing member 24 arranged at an outer side of the structural main column 21. The continuous single beams 1 are arranged at the outer side of the structural main column 21. Please refer to FIG. 14-2. FIG. 14-2 is a diagram of the reinforcing member 24 according to an embodiment of the present invention. The reinforcing member 24 can include a reinforced concrete column 215. The reinforced concrete column 215 includes the steel bar 516, the stirrup 506, and the concrete 60. Please refer to FIG. 14-3. FIG. 14-3 is a diagram of the reinforcing member 24 according to an embodiment of the present invention. In this embodiment, the reinforcing member 24 can include a steel column 215. The concrete or the cement mortar 601 is filled between a space between the steel column 215 and the structural main column 21.

[0063] Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

Claims

1. A three-dimensional lightweight steel framework comprising a beam, a purlin and/or a stringer, a column, a wall body, a floor slab and/or a roof, and a lateral-force-resistant rod and/or tension braces, wherein the beam is a continuous double beam comprising two identical or different continuous single beams attached at both sides of the column, the continuous single beam and the column are continuous and not interrupted at a cross joint of the continuous single beam and the column.
2. The three-dimensional lightweight steel framework of claim 1, wherein the column comprises a structural main column, a small column, a reinforcing column in the wall body, a brace, and a vertical column and/or a truss beam brace, the beam comprises a horizontal beam, an inclined beam, an upper chord beam and/or a bottom chord beam, and/or a ground tie beam, the continuous single beam is formed by at least one of a L-shaped steel member, a U-shaped steel member, a C-shaped steel member, a Z-shaped steel member, a plate-shaped steel member, and a slice truss, the purlin or the stringer is formed by at least one of the U shaped steel member, the C-shaped steel member, the Z-shaped steel member, and the slice truss, the slice truss comprises an upper chord, a bottom chord, and a shear re-

sistance brace, the upper chord or the bottom chord is formed by the L-shaped steel member, and the shear resistance brace is formed by the L-shaped steel member, the plate-shaped steel member, or a rounded steel member, the column is formed by at least one of the C-shaped steel member, an opened square-shaped steel member, a bent square-shaped steel member, and a square-shaped steel member, the opened square-shaped steel member is filled with concrete and/or cement mortar, the bent square-shaped steel member is formed by cold rolling a steel plate, two ends of the steel plate are bent to form two buckled edges with 90 degrees, and the two buckled edges are engaged together via rivets arranged at intervals, the continuous single beam is connected to the column by means of a bolt passing through a column connection hole on the column and a beam connection hole on a web of the continuous single beam.

3. The three-dimensional lightweight steel framework of claim 2, wherein the L-shaped steel member, the U-shaped steel member, the C-shaped steel member, the Z-shaped steel member and the opened square-shaped steel member are provided with curled edges, an upper flange and a bottom flange of the U-shaped steel member, an upper flange and a bottom flange of the C-shaped steel member, or an upper flange and a bottom flange of the Z-shaped steel member have an identical width or different widths, the L-shaped steel member, the U-shaped steel member, the C-shaped steel member, the Z-shaped steel member, the opened square-shaped steel member, the bent square-shaped steel member, and the plate-shaped steel member are formed by cutting and/or cold rolling a galvanized steel reel.
4. The three-dimensional lightweight steel framework of claim 1, wherein the continuous single beam comprises a plurality of single beams connected via at least one overlapped connection or at least one beam connector.
5. The three-dimensional lightweight steel framework of claim 1, wherein the floor slab is a reinforced lightweight composite floor slab, the reinforced lightweight composite floor slab comprises a lightweight composite floor slab, the lightweight composite floor slab, the purlin, and the lateral-force-resistant rod and/or a ceiling are connected integrally by at least one floor connector, the lightweight composite floor slab is installed over the purlin, and the lateral-force-resistant rod and/or the ceiling are built under the purlin.
6. The three-dimensional lightweight steel framework of claim 5, wherein the lightweight composite floor slab comprises a floor deck, the floor deck is formed

by a profiled steel sheet, the profiled steel sheet is a corrugated profiled steel sheet or a folded profiled steel sheet, the profiled steel sheet is with a 0.2 to 1.0 millimeter thickness and a 30 to 50 millimeter groove depth, the profiled steel sheet is filled with concrete and/or cement mortar, the concrete and/or the cement mortar is framed by an internal anti-cracking mesh and/or anti-cracking fiber, a height difference between the concrete and/or the cement mortar and a peak of the profiled steel sheet is less than 50 millimeter, the profiled steel sheet is connected to the purlin by the floor connector, the floor connector comprises a self-tapping screw, a sleeve and/or a bearing gasket, the sleeve is tightly attached to the self-tapping screw, the sleeve is made of metal or plastic, at least one side of the sleeve is expanded to form the bearing gasket, the purlin is disposed at intervals of less than 180 centimeter, at least one pair of opposite corners of the lightweight composite floor slab are bounded by the lateral-force-resistant rod, the lateral-force-resistant rod is formed by a strip steel, the strip steel is connected to the purlin by the self-tapping screw, the ceiling comprises a first expanded ribbed mesh, the first expanded ribbed steel mesh comprises a first V-shaped rib and a first expanded mesh surface, the first expanded ribbed steel mesh is connected to the purlin by the self-tapping screw and/or an air nail, the ceiling is filled with the cement mortar, and the cement mortar is framed by the internal anti-cracking mesh and/or the anti-cracking fiber.

7. The three-dimensional lightweight steel framework of any of claims 1 to 6, wherein the continuous single beam is an embedded continuous single beam, an upper flange and a bottom flange of the embedded continuous single beam formed by the L-shaped steel member, the C-shaped steel member or the Z-shaped steel member and corresponding to the column are cut off, so that the column is embedded into the embedded continuous single beam at across joint of the column and the embedded continuous single beam, the embedded continuous single beam is connected to the column by means of the bolt passing through the column connection hole on the column and the beam connection hole on a web of the embedded continuous beam.
8. The three-dimensional lightweight steel framework of any of the claims 1 to 6, further comprising a reinforced structure.
9. The three-dimensional lightweight steel framework of claim 8, wherein the bottom chord beam is formed by the opened square-shaped steel member with an upward opening, a part of the opened square-shaped steel member overlapping the column or the brace is cut off, the opened square-shaped steel

member is connected to the column or the brace by means of the bolt passing through the beam connection hole on a web of the opened square-shaped steel member and the column connection hole on the column or the brace, so as to form the reinforced structure.

10. The three-dimensional lightweight steel framework of claim 8, wherein the reinforced structure is a positioning hole arranged at an intersection of centerlines of the beam and the column, and the positioning hole is for falsely fixing the beam and the column by means of the bolt or a conical steel bar.
11. The three-dimensional lightweight steel framework of any of claims 8, 9, and 11, wherein a space between two continuous single beams, and/or a cavity between the columns, and/or a cavity of the opened square-shaped steel member of the bottom chord beam is filled with the concrete and/or the cement mortar, so as to form the reinforced structure.
12. The three-dimensional lightweight steel framework of any of claims 8, 9, and 11, wherein the reinforced structure is a plurality of self-tapping screw disposed at a periphery of the bolt and for falsely fixing the beam and the column after the beam and the column are calibrated, and the plurality of self-tapping screw is removed after the cavity between the columns or the opened square-shaped steel member of the bottom chord beam is filled with the concrete and/or the cement mortar.
13. The three-dimensional lightweight steel framework of any of claims 8, 9, and 11, wherein a supporting steel member is arranged in the space between the two continuous single beams, and/or in the cavity between the columns or the opened square-shaped steel member forming the bottom chord beam, where the concrete cement and/or the cement mortar is filled, so as to form the reinforced structure, and the supporting steel member is a steel bar, a stirrup, or a pre-stressed steel wire.
14. The three-dimensional lightweight steel framework of claim 13, wherein the stirrup is a square stirrup, a rounded stirrup, a helical stirrup or a rounded steel mesh, and the pre-stressed steel wire is provided with a sleeve.
15. The three-dimensional lightweight steel framework of claim 13 or 14, wherein the steel bar, the sleeve and the pre-stressed steel wire pass through the column.
16. The three-dimensional lightweight steel framework of claim 8, wherein the reinforced structure member is a thickened steel sheet surrounding the beam con-

nection hole on the beam or the column connection hole on the column, and the thickened steel sheet is connected to the beam or the column by means of a rivet, and/or a riveting clinching joint, and/or by welding.

17. The three-dimensional lightweight steel framework of claim 8, wherein the reinforced structure is a punching groove surrounding the connection hole of the beam, the punching groove is embedded into the column connection hole on the column, and a diameter of the column connection hole on the column is greater than a width of the punching groove.
18. The three-dimensional lightweight steel framework of claim 8, wherein the reinforced structure is an additional exterior member attached on an outer side of the beam, the additional exterior member is formed by the L-shaped steel member, the U-shaped steel member, the C-shaped steel member, the plate-shaped steel member, the square-shaped steel member, or a square-shaped wooden member.
19. The three-dimensional lightweight steel framework of claim 18, wherein a thermal insulating gasket is arranged between the beam and the additional exterior member.
20. The three-dimensional lightweight steel framework of claim 8, wherein the column is surrounded by a spot-welded steel mesh, a woven steel mesh, or an expanded steel mesh and connected to the wall by the cement mortar, so as to form the reinforced structure.
21. The three-dimensional lightweight steel framework of claim 8, wherein the reinforced structure is an integrally-positioned steel frame, the integrally-positioned steel frame comprises an angular connector, a bolt-reinforced gasket, a frame body, an embedded bolt, and an anti-pulling nut, the embedded bolt is connected to a base of the column via the angular connector, the frame body is formed by the C-shaped steel member having an upward opening, an embedded hole and curled edges at ends of the upward opening, the reinforced gasket is arranged above the embedded hole and provided with a positioning hole, the C-shaped steel member is filled with the concrete after the embedded bolt is fixed, and the base of the column is arranged on the integrally-positioned steel frame.
22. The three-dimensional lightweight steel framework of claim 21, wherein the embedded bolt is screwed with the anti-pulling nut below the bolt-reinforced gasket or the embedded hole of the C-shaped steel member.

23. The three-dimensional lightweight steel framework of claim 8, wherein the reinforced structure is a reinforcing member attached to an outer side of the structural main column, the reinforcing member comprises steel columns and/or reinforced concrete columns surrounding the structural main column, the steel columns and/or the reinforced concrete columns are continuous or interrupted at the cross joint of the beam and the column, and the concrete or the cement mortar is filled between a space between the steel columns and the structural main column.
24. The three-dimensional lightweight steel framework of claim 8, wherein the reinforced structure is a precast concrete wall slab and/or a precast lightweight concrete wall slab and/or a precast hollow concrete wall slab installed between the two continuous double beams.
25. The three-dimensional lightweight steel framework of claim 8, wherein the reinforced structure is a composite wall body installed between the columns, the composite wall body comprises a composite wall surface, the composite wall surface comprises a second expanded ribbed mesh, a cement mortar layer, a fastener, and a stressed-skin structure, the composite wall surface is attached to at least one side of the column, when the composite wall surface is attached on only one side of the column, the lateral-force-resistant rod is arranged at the other side of the column.
26. The three-dimensional lightweight steel framework of claim 25, wherein the second expanded ribbed mesh comprises a second V-shaped rib and a second expanded mesh surface, the second expanded ribbed mesh is fixed onto the column by the fastener, the fastener is a self-tapping screw or an air nail, and the lateral-force-resistant rod is formed by a strip steel.
27. The three-dimensional lightweight steel framework of claim 26, wherein the composite wall body further comprises a reinforcing member, the reinforcing member comprises a fixation gasket and an anti-cracking member, the fixation gasket is tightly attached to a groove of the second V-shaped rib for seating the air nail, the fixation gasket is made of hard plastic, and the anti-cracking member is a fiberglass mesh or a spot-welded metal mesh, or fiber in the concrete or the cement mortar.
28. The three-dimensional lightweight steel framework of claim 8, wherein the reinforced structure is a composite wall body installed between the columns, the composite wall body encloses the structural main column, the small column and/or the reinforcing column in the wall body, and the brace installed between the beam and the column, the composite wall body

comprises two second expanded ribbed meshes, at least one tying member, an insulating layer, and a supporting member, the two second expanded ribbed meshes are fastened onto two sides of the structural main column, the small column and the reinforcing column by at least one fastener, the at least one fastener is a self-tapping screw or an air nail, the wall body is disposed between the second expanded ribbed meshes, the insulating layer is installed between the second expanded ribbed meshes, the second expanded ribbed mesh comprises a second V-shaped rib and a second expanded mesh surface, the supporting member is situated at an outer side of the second V-shaped rib, the tying member is a steel wire or plastic wire, the tying member ties to the second V-shaped rib of the second expanded ribbed mesh and/or the supporting member vertically disposed on the second V-shaped ribs of the second expanded ribbed mesh, and the wall body is filled with building waste residue, soil, grass, concrete or lightweight concrete.

29. The three-dimensional lightweight steel framework of claims 8 or 27, wherein the reinforced structure is the lateral-force-resistant rod arranged at a side of the column, the lateral-force-resistant rod is made of the strip steel, an upper end of the lateral-force-resistant rod is provided with a rod connection hole and connected to the column by the bolt passing through the rod connection hole on the lateral-force-resistant rod and the column connection hole on the column, and a lower end of the lateral-force-resistant rod is provided with a tensioning hole and curled by 90 degrees, so as to be fixed onto the side of the column by the self-tapping screws.
30. The three-dimensional lightweight steel framework of any of claims 1 to 6, wherein the ground tie beam comprises two identical continuous single beams, the continuous single beam is formed by the slice truss, the slice truss comprises the upper chord, the bottom chord and the shearing-resistant brace, the upper chord and/or the bottom chord are formed by the L-shaped steel member, and the shearing-resistant brace is formed by the L-shaped steel member and/or the plate-shaped steel member and/or the rounded steel member.

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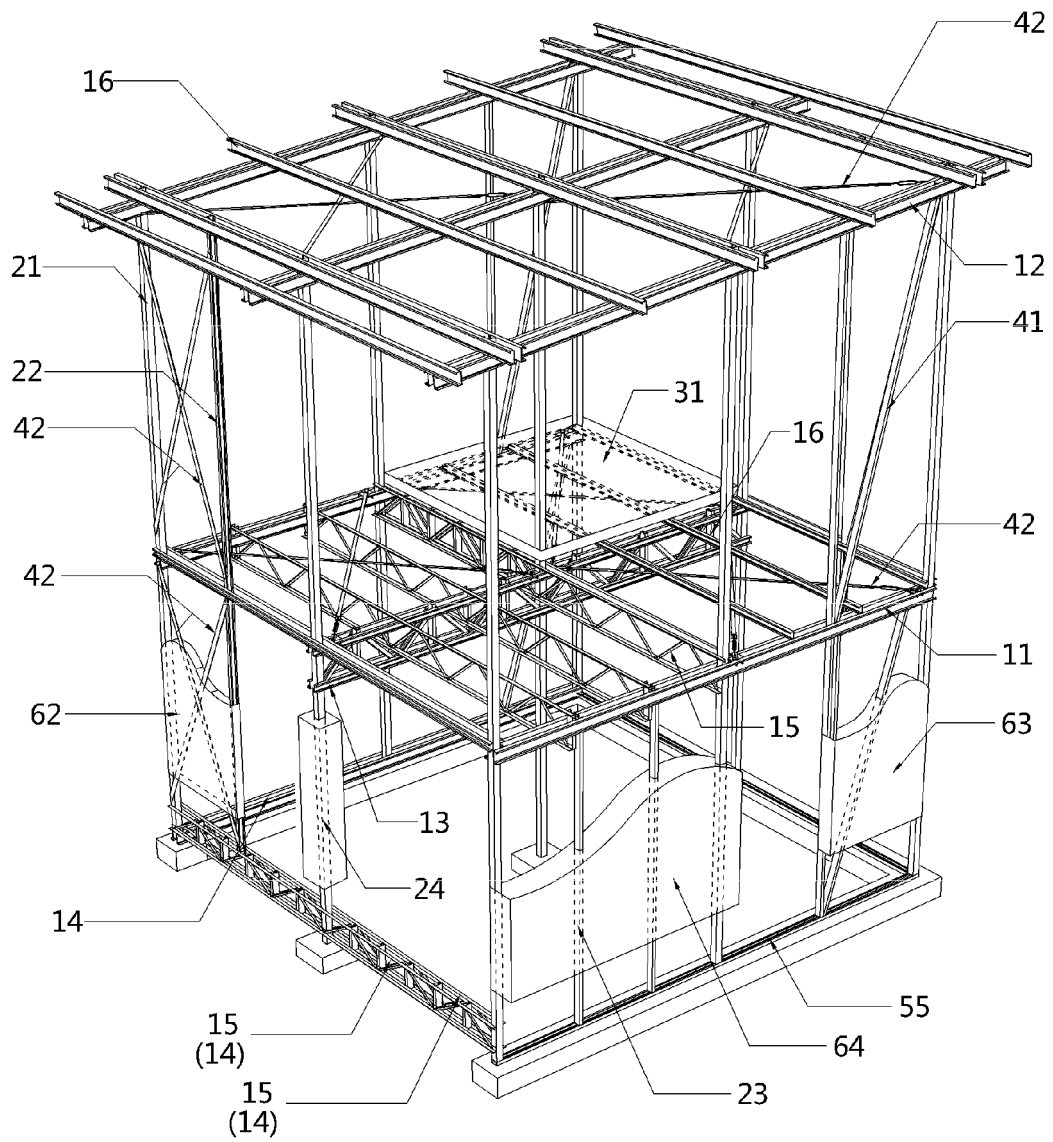


FIG. 1

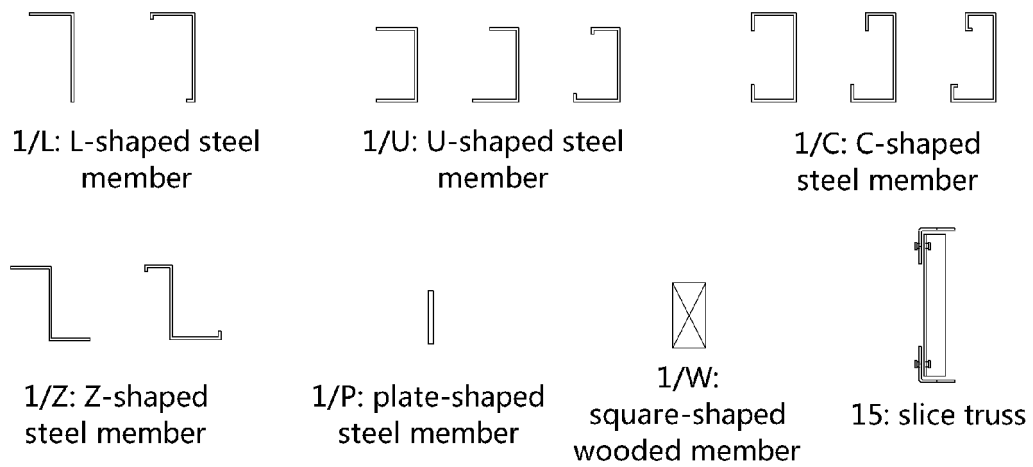


FIG. 2-1

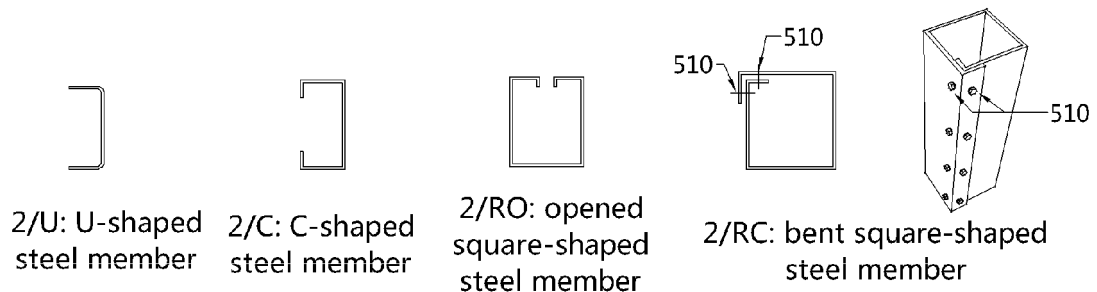


FIG. 2-2

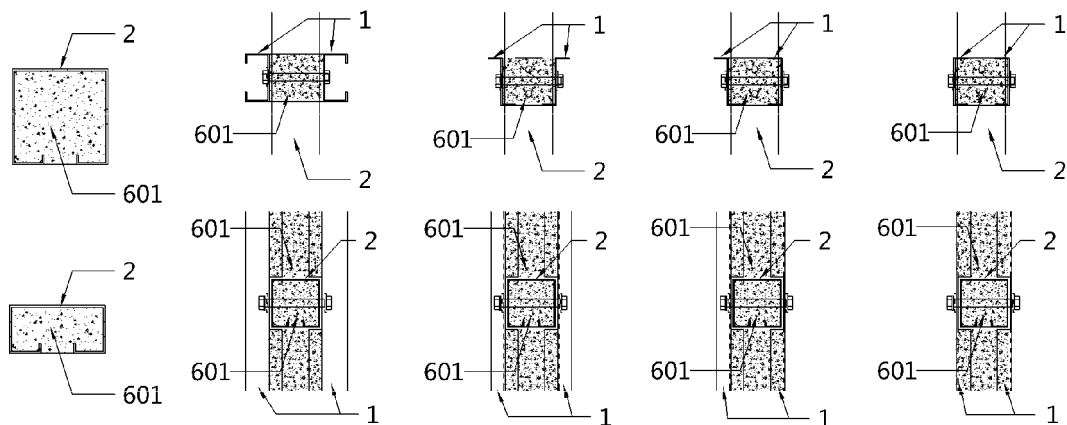


FIG. 2-3

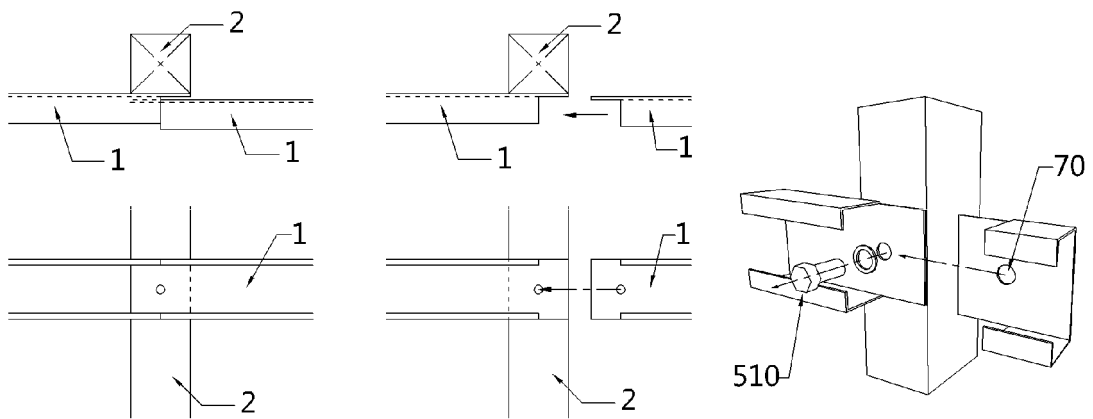


FIG. 3-1

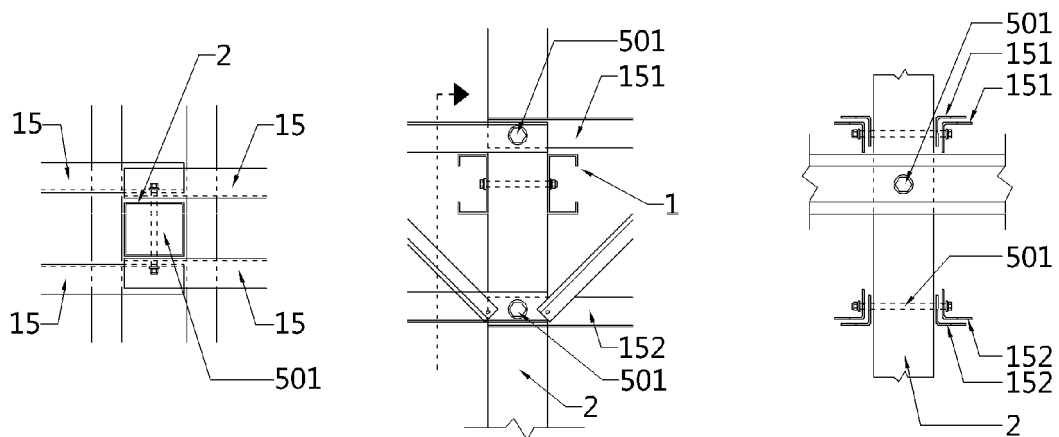


FIG. 3-2

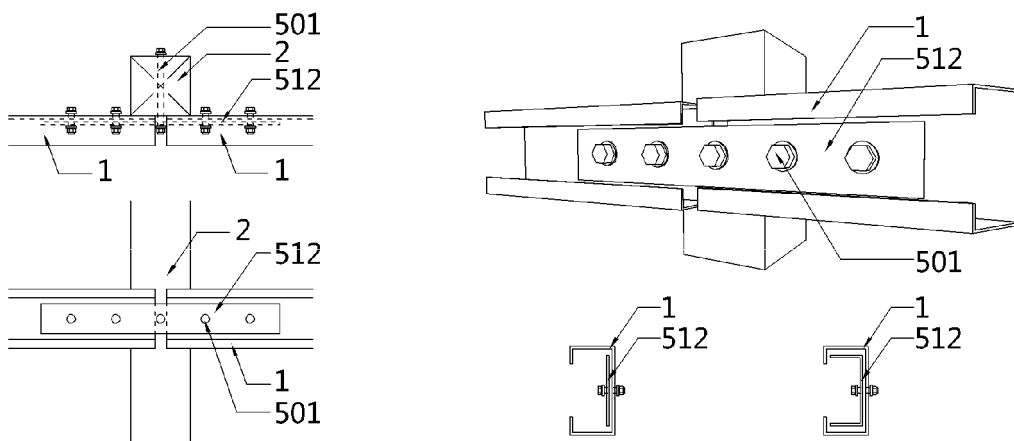


FIG. 3-3

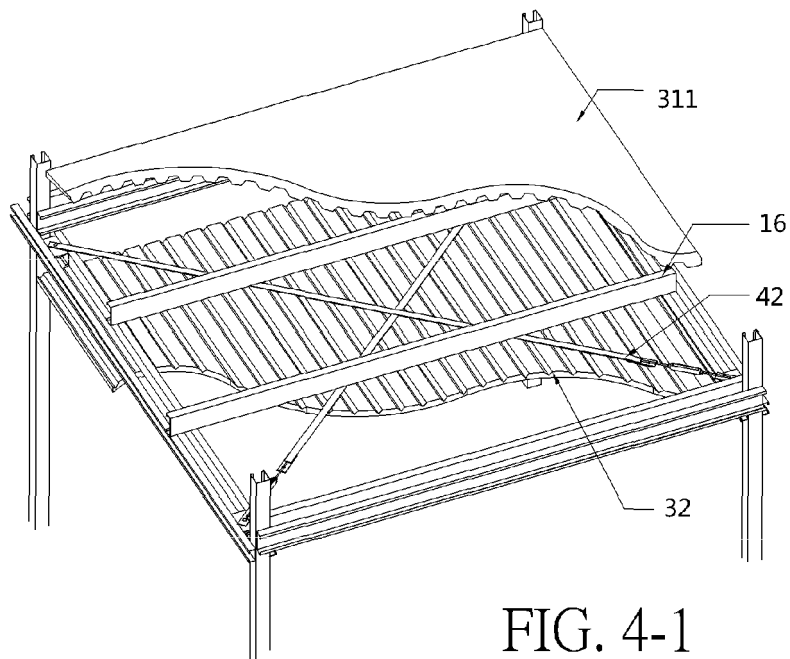


FIG. 4-1

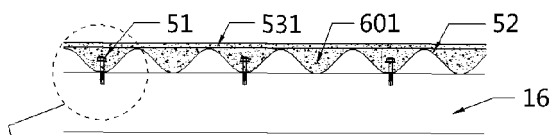


FIG. 4-2

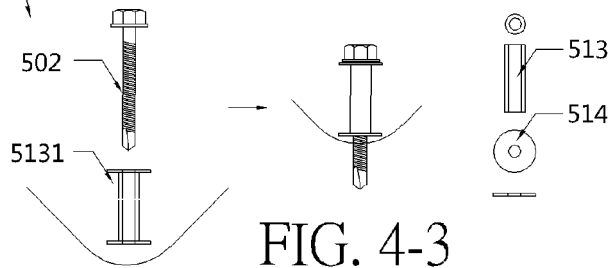


FIG. 4-3

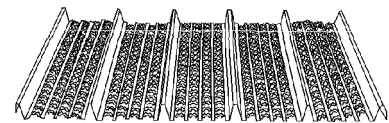


FIG. 4-6

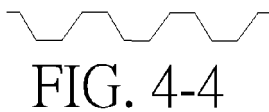


FIG. 4-4



FIG. 4-5

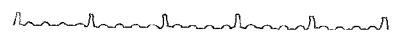


FIG. 4-7

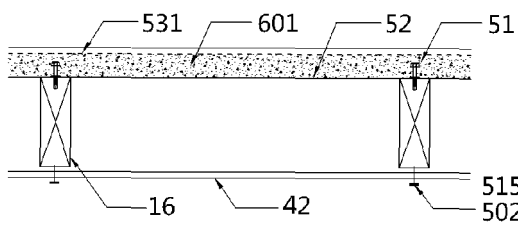


FIG. 4-8

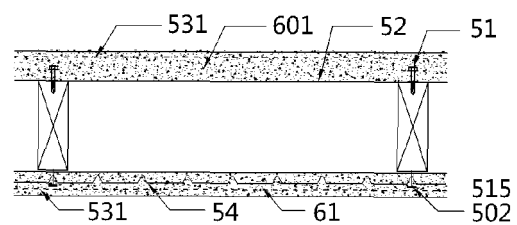
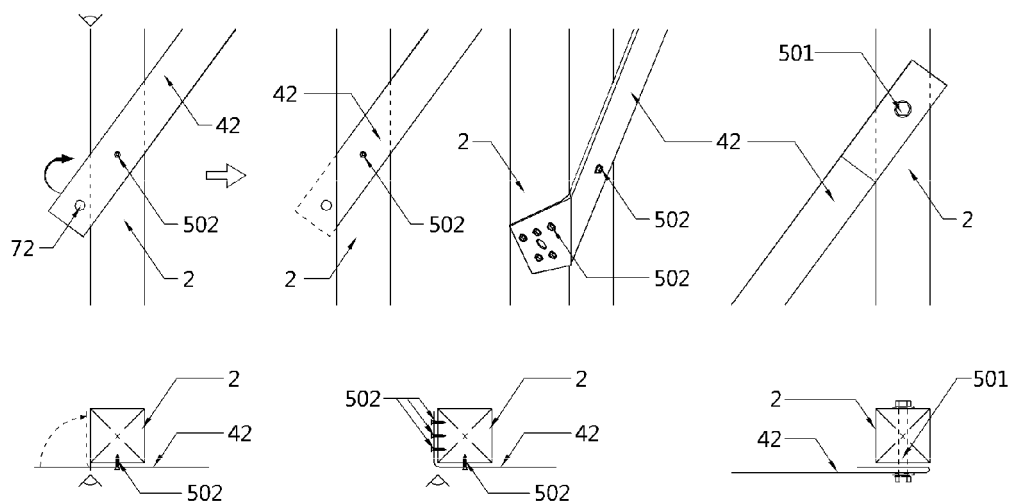
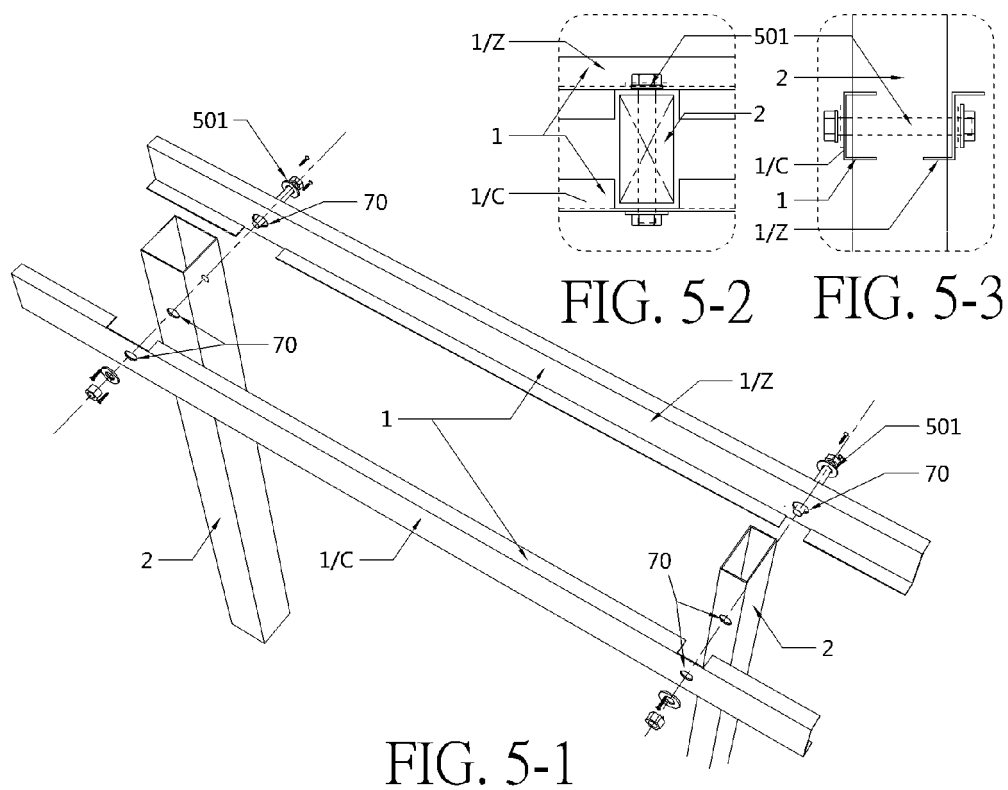
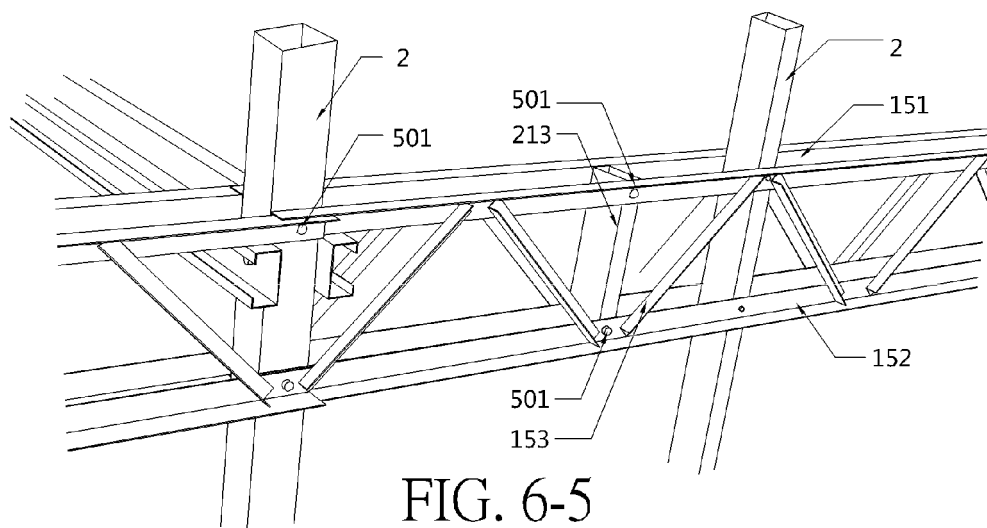
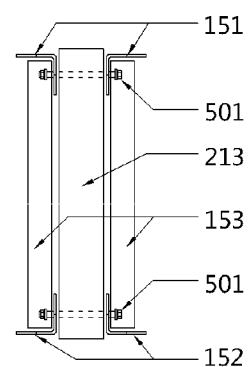
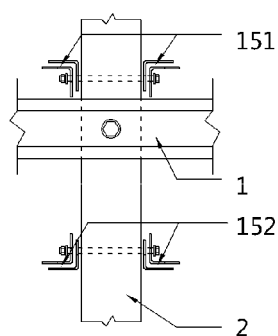
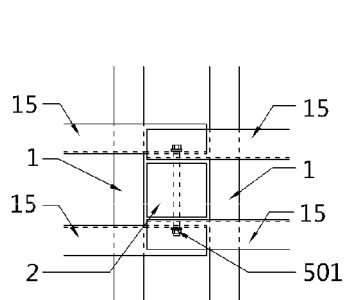
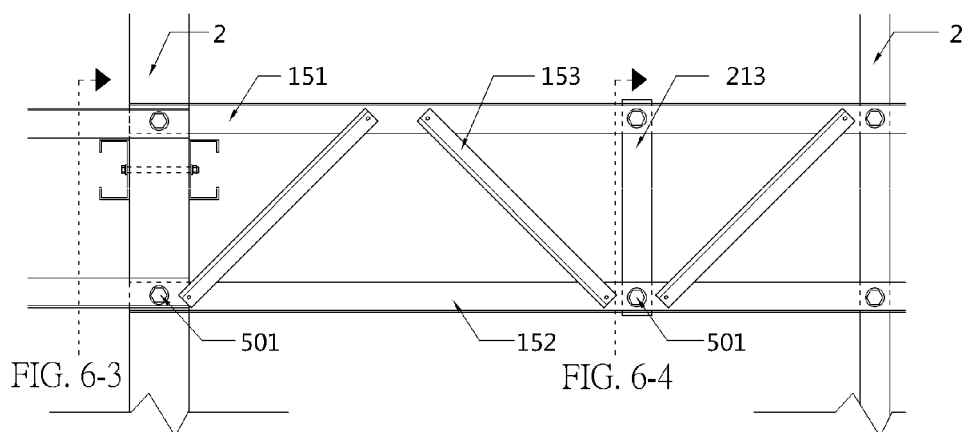


FIG. 4-9





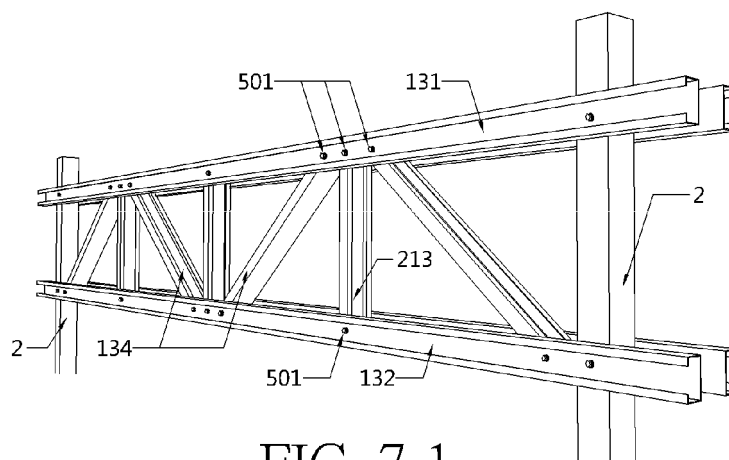


FIG. 7-1

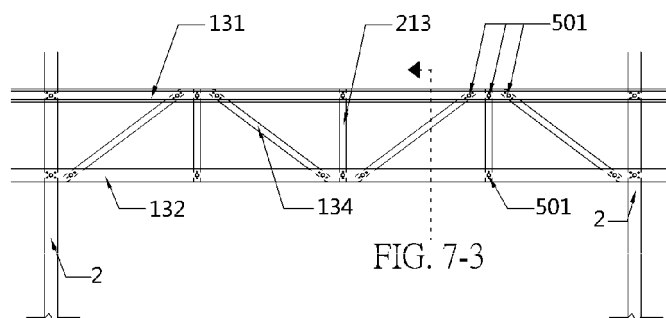


FIG. 7-3

FIG. 7-2

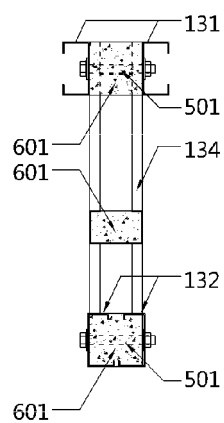


FIG. 7-3

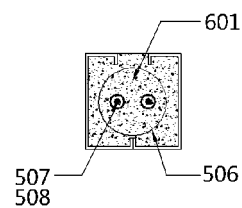
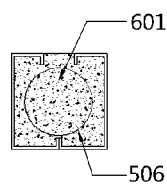
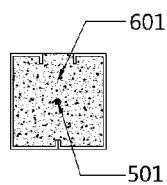


FIG. 7-4

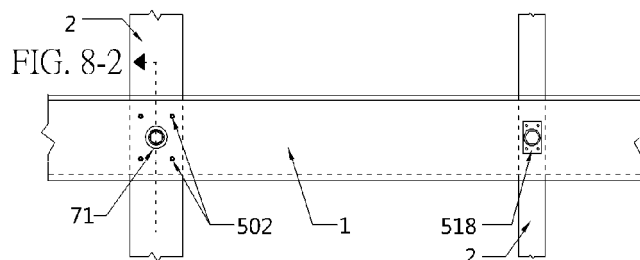


FIG. 8-1

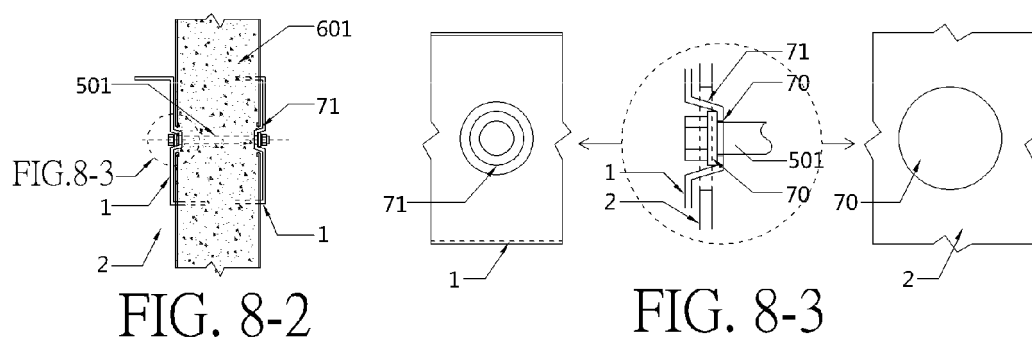


FIG. 8-2

FIG. 8-3

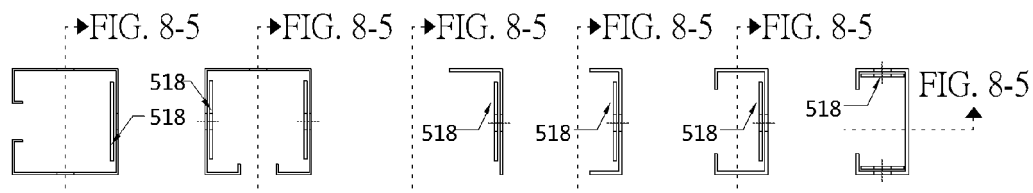


FIG. 8-4

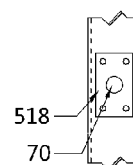
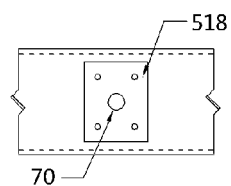


FIG. 8-5

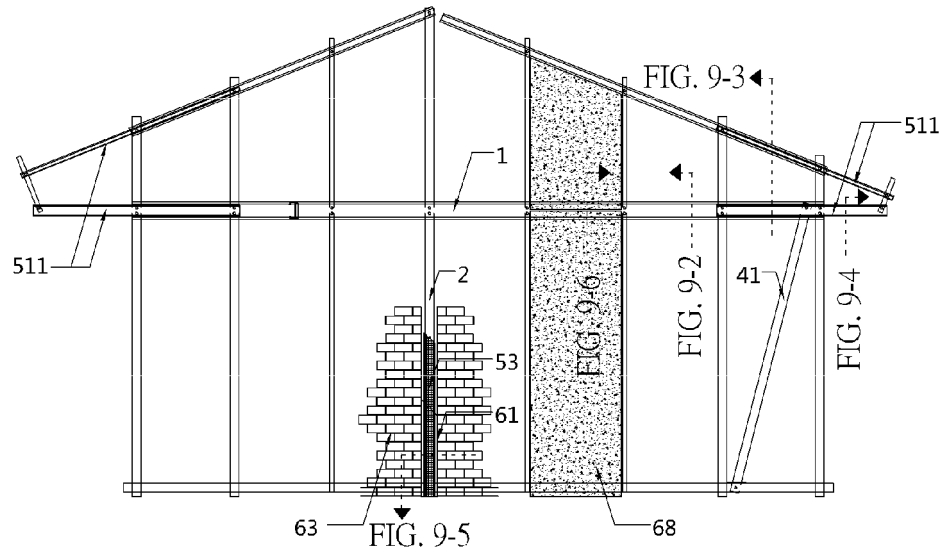


FIG. 9-1

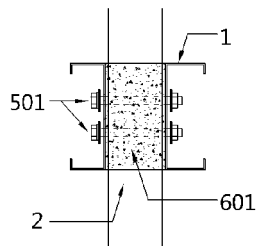


FIG. 9-2

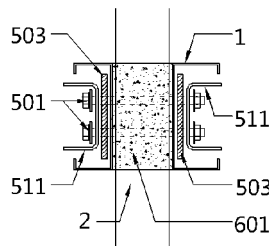


FIG. 9-3

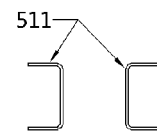


FIG. 9-4

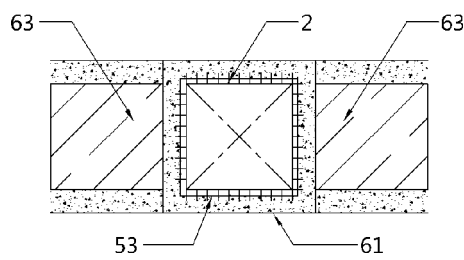


FIG. 9-5

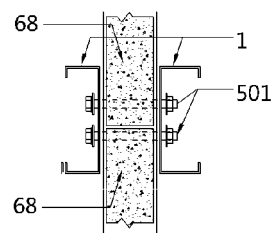


FIG. 9-6

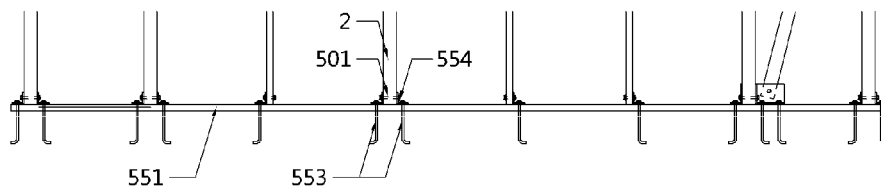


FIG. 10-1

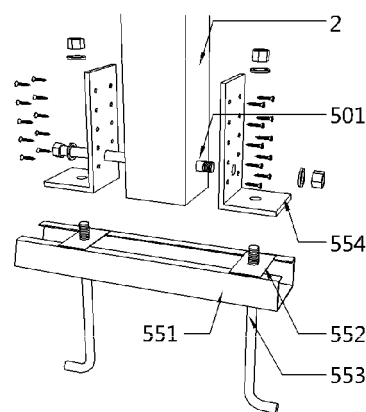


FIG. 10-2

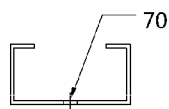


FIG. 10-3

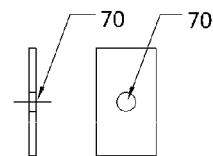


FIG. 10-4

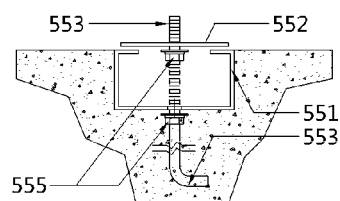


FIG. 10-5

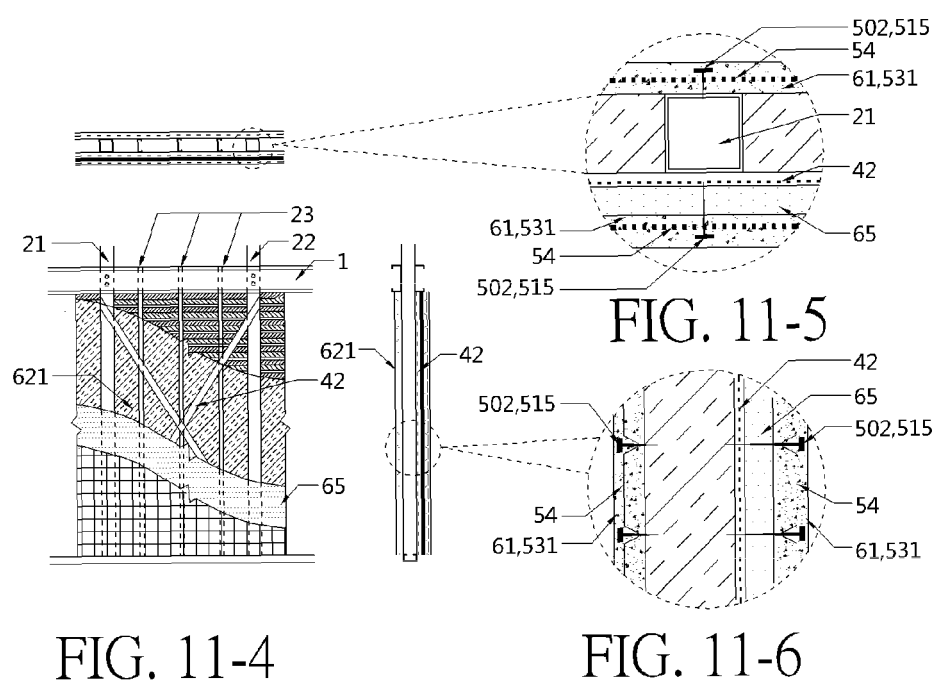
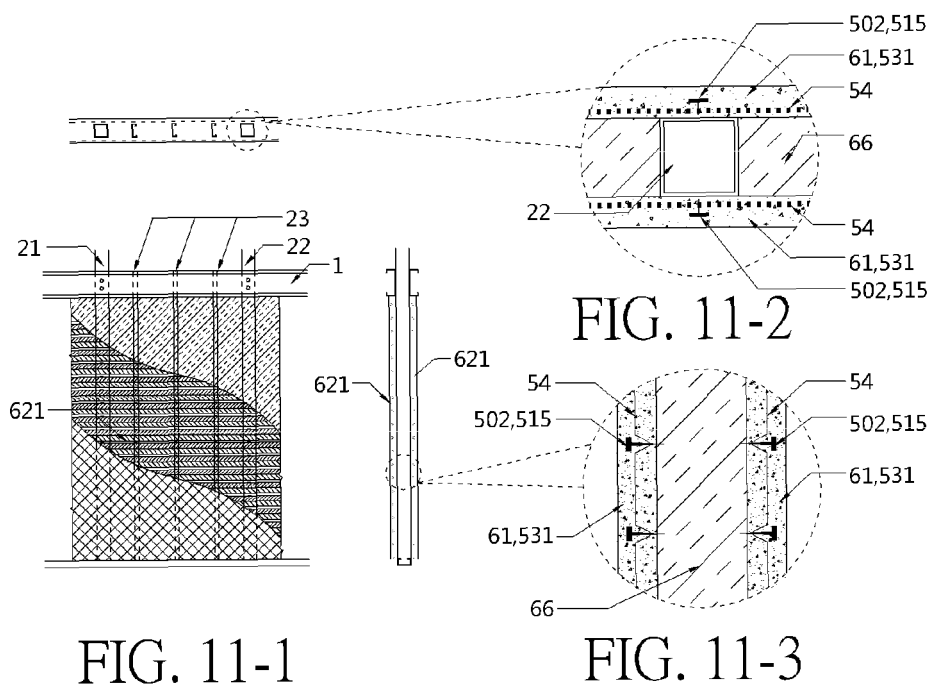


FIG. 11-6

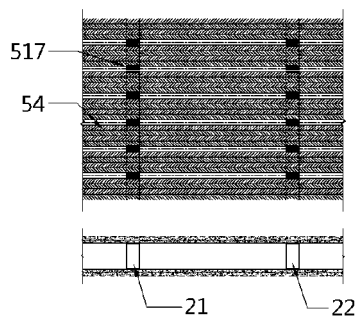


FIG. 12-1

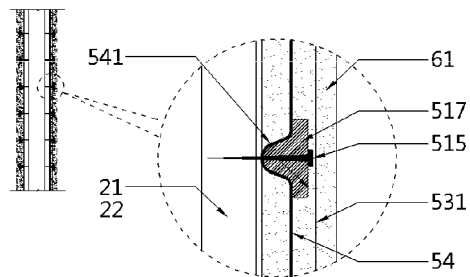


FIG. 12-2

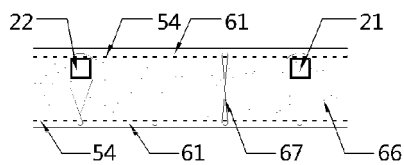


FIG. 13-1

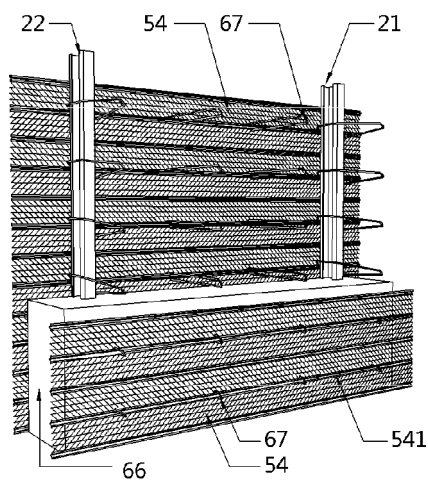
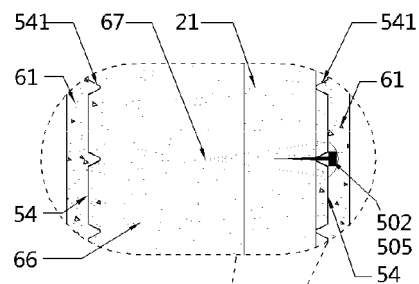


FIG. 13-2

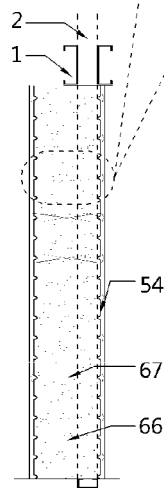
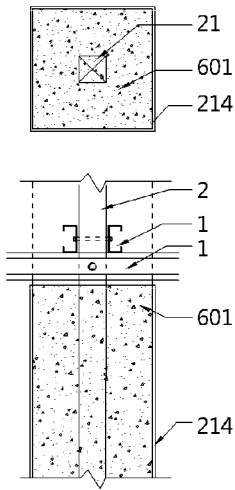
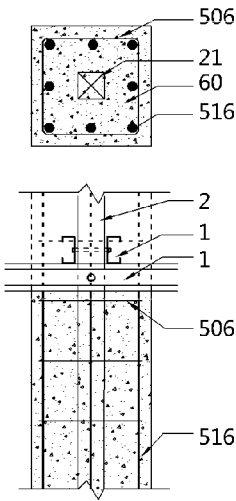
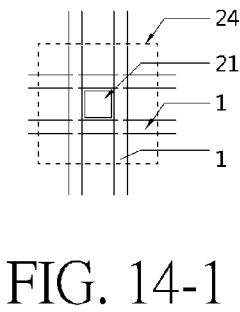


FIG. 13-3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/071574

A. CLASSIFICATION OF SUBJECT MATTER

E04B 1/24 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E04B

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

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

EPODOC, WPI, CNPAT, CNKI, CNTXT: roof truss, continuous, covering, floor slab, light, steel, roof, frame, double, beam, column, slab, floor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PY	CN 103790231 A (CHENGDU CHANGMIN CENTURY CONSTRUCTION CO., LTD.), 14 May 2014 (14.05.2014), description, pages 2-6, claims 1-13, and figures 1-16	1-5, 7-20, 23-30
Y	CN 201502135 U (XIE, Yingjun), 09 June 2010 (09.06.2010), description, pages 1 and 3-4, claim 10, and figures 1-6	1-5, 7-20, 23-30
PY	CN 103711230 A (XIE, Yingjun), 09 April 2014 (09.04.2014), description, pages 1-4, claims 1-14, and figures 1-5c	25-28
A	CN 203296170 U (BEIJING ASIA-PACIFIC KEJIAN STEEL STRUCTURE TECHNOLOGY DEVELOPMENT CO., LTD.), 20 November 2013 (20.11.2013), the whole document	1-30
A	US 4342177 A (SMITH, D.A.), 03 August 1982 (03.08.1982), the whole document	1-30
A	TW M377446 U (XIE, Y.J.), 01 April 2010 (01.04.2010), the whole document	1-30

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Date of the actual completion of the international search
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LUO, Xiqu

Telephone No.: (86-10) 62084182

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/071574

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 103114668 A (XIE, Yingjun), 22 May 2013 (22.05.2013), the whole document	6, 21, 22

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2015/071574

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CN 103790231 A	14 May 2014	None	
CN 201502135 U	09 June 2010	US 2012192520 A1	02 August 2012
		WO 2011020283 A1	24 February 2011
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CN 203296170 U	20 November 2013	None	
US 4342177 A	03 August 1982	None	
TW M377446 U	01 April 2010	None	
CN 103114668 A	22 May 2013	WO 2014117719 A1	07 August 2014

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REFERENCES CITED IN THE DESCRIPTION

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- CN 201310664792 [0009]
- CN 201110023291 [0010]