(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 December 2015 (03.12.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/184476 A1

(51) International Patent Classification:
*E04B 5/32* (2006.01)

(21) International Application Number:
PCT/VN2015/000006

(22) International Filing Date:
26 May 2015 (26.05.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1-2014-01776 30 May 2014 (30.05.2014) VN

(72) Inventor; and
(71) Applicant : **DO, Duc Thang** [VN/NA]; No. 45, Alley 4/21, Phuong Mai Ward, Dong Da District, Hanoi (VN).

(74) Agent: **ACTIP PATENT LIMITED**; 7th Fl., Lac Hong Building, 85 Le Van Luong Rd., Thanh Xuan Dist., Hanoi (VN).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17**:

— *of inventorship (Rule 4.17(iv))*

**Published**:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) **Title**: PRECAST CONCRETE FALSEWORK BUBBLEDECK ELEMENT AND PROCESS OF MANUFACTURING THEREOF

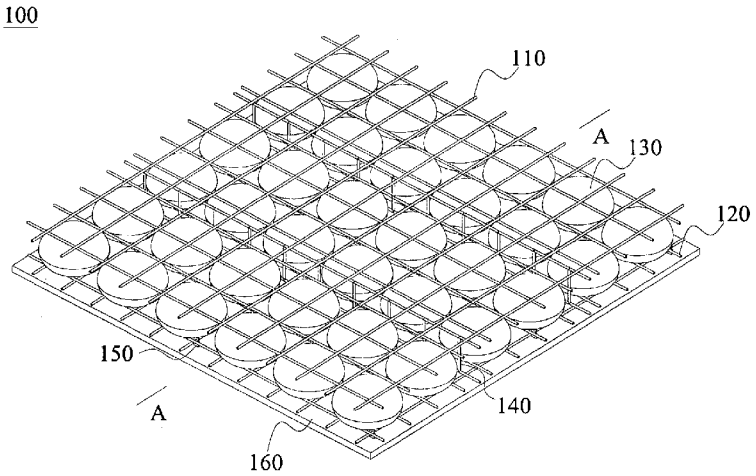


Fig.2

(57) **Abstract**: The invention relates to the precast concrete falsework bubbledeck element, including: upper steel mesh sheet (110); lower steel mesh sheet (120); many hollow balls (130) fixed between a upper and lower steel mesh sheets (110, 120) so that adjacent hollow balls (130) will be contact with each other; reinforcement frames (140) are placed along the length of bubbledeck elements, and fixed between the upper and lower steel mesh sheets (110, 120) in vertical direction by spot welding; connectors (150) fixed to the lower steel mesh sheet (120); and bottom falsework (160) made of UHPC so that the bottom falsework (160) covers a part of leg of connector (150) to be fixed to the lower steel mesh sheet (120) but separates a certain distance from the lower steel mesh sheet (120).

WO 2015/184476 A1

# Precast Concrete Falsework Bubbledeck Element and Process of Manufacturing thereof

## Field of the Invention

The present invention relates to a precast concrete falsework bubbledeck element and procedure of manufacturing thereof. More particularly, the present invention relates to the precast concrete falsework bubbledeck elements which produced in the factory, and process of manufacturing this precast concrete falsework bubbledeck element which can be carried out easily, saving labor force and lower cost.

## Background of the Invention

Nowadays, bubbledeck elements are widely applied all over the world in civil construction field especially in multi-storey buildings because it has many advantages in comparison with the normal solid concrete slab. Danish patent No. DK172307B1 disclosed bubbledeck elements which have predetermined size and they are transported to construction sites by vehicle and lift by crane. This element includes many hollow balls which are fixed between upper and lower steel mesh sheets by using many spacer and reinforcement elements, with concrete layer covered all of lower steel mesh sheet and a part of hollow balls. However, the bubbledeck element of this patent has some disadvantages as follows:

(1) Because depth of concrete layer is 60 mm resulting in hollow concrete slab be very heavy, it should to use a huge capacity crane to lift these elements to the planned position and it is also very difficult to access the crane to the desired position;

(2) Because concrete layer covered all of lower steel mesh sheet, it is very difficult to join the steel bars of bubbledeck elements with each other, thus

it can not to directly joint two lower steel mesh sheet of two adjacent bubbledeck elements, which leads the forming of weak connection and difficult to ensure the ability to transmit force between the concrete slab structures;

(3) Costing more steel used to fabricate stiffeners which are used to serve in moving and lifting the deck structure.

Vietnamese patent No. VN10002 disclosed a bubbledeck element which has many hollow balls are fixed between upper and lower steel mesh sheets by using connector bars to create the skewed connection system in the sinusoidal form along the longest direction of the slab structure, steel or plywood falseworks is detachable fixed to lower steel mesh sheets by using the bolts and screws. These deck structures resolved the problems of slab structure of Danish patent No. DK172307 B1 such as reduce weight of slab structure, adapt well with assembling work on ground surface; and the falseworks can be removed for reusable after finishing hollow concrete slab. However, these bubbledeck elements still remain some disadvantages as follows: falseworks should be removed from ceiling surface after casting concrete for hollow concrete slab, which resulted in the ends of bolts fixed falseworks be projected from ceiling surface, this may reduce the surface quality of ceiling, increase in labor force for removing falseworks and bolts from ceiling and finishing surface quality of ceiling; and it need to install formworks at the boundary position of concrete slab before casting concrete for hollow concrete slab.

To overcome the above disadvantages, the present invention provides bubbledeck element which is lighter, more stable to save material, labor force on construction site, and easier to execute on sites, increase the finishing and anti-breakage for hollow concrete slab.

**Summary of invention**

The purpose of present invention is to provide the precast concrete

falsework bubbledeck element, which is manufactured in the factory, lighter, strong for lifting by crane, save material, labor force on construction site.

In order to obtain the above purpose, the first embodiment of the present invention provides the precast concrete falsework bubbledeck element, including: upper steel mesh sheet consisting of many steel bars which are connected with each other by welding or joining to produce square mesh with designed dimension; lower steel mesh sheet similar to upper steel mesh sheet, which is laid parallel with the upper steel mesh sheet; many hollow balls of spherical or oval shapes, in which each ball shall be fixed between respective meshes of upper and lower steel mesh sheets so that adjacent hollow balls will be contact with each other; reinforcement frames which are spaced, preferably 0.7 m, along the length of bubbledeck element, and fixed between upper and lower steel mesh sheets in vertical direction by spot welding, thereby hollow balls are tight fixed between upper and lower steel mesh sheet; many connectors fixed to the lower steel mesh sheet at the optionally positions depending on the actual conditions during manufacturing in each direction; and bottom falsework made of Ultra High Performance Concrete (UHPC) with 10-12 mm depth so that the bottom falsework coveres a part of leg of connector to be fixed to the lower steel mesh sheet but separates a certain distance from the lower steel mesh sheet, thereby connection welding the steel bars of lower steel mesh sheets between two adjacent bubbledeck elements can be performed and controlled easily, and ensure the good reinforcement between the lower steel mesh sheets in bidirectional.

According to the present invention, the connector includes a body and a leg perpendicular to each other, in which the body comprises a horizontal gap with the width equal to the diameter of the steel bars of the lower steel mesh sheet, and the leg is buried in UHPC layer of bottom falsework.

According to the embodiment of invention, the bubbledeck element can

further include edge falsework, which its height is equal to the thickness of the concrete slab, is one piece monolithic cast with and perpendicular to the bottom falsework, and is fixed to bottom falsework by anchor bars. Cable anchor holes are formed at the edge falsework to permit the post-tensioning cables placed in concrete slab.

In the present invention, the mesh of the upper and lower steel mesh sheets is square or rectangular with designed dimension.

In the present invention, the hollow balls can be replaced by the frustum of pyramid blocks with square or rectangular bottom and curved edges.

In the present invention, the reinforcement frame is structured in form of strip rectangular mesh, including two steel bars, which are arranged in parallel, and link steel bars, which are fixed to two steel bars in horizontal and oblique direction, in which the distance between two steel bars is the same as the distance between two steel mesh sheets.

According to another embodiment, the present invention provides a process of manufacturing the precast concrete falsework bubbledeck element, comprising the steps: (i) placing the lower steel mesh sheet at the designed position; (ii) welding the reinforcement frames to the lower steel mesh sheet at the designed positions in vertical direction; (iii) putting the hollow balls on meshes of the lower steel mesh sheet, in which the hollow balls are separated by one mesh in horizontal and vertical direction; (iv) placing the upper steel mesh sheet onto hollow balls and connecting it to the reinforcement frames by welding; (v) fixing connectors to the lower steel mesh sheet; (vi) casting the bottom falsework by crane the structure element including hollow balls fixed between the upper and lower steel meshes into the mold having liquid UHPC layer with depth of 10-12 mm so that this layer covered a part of leg of connectors; and (vii) curing the concrete bottom falsework in saturated steam,

removing the mold, and natural moist curing.

In the embodiment, before casting step, the process of the present invention can further include placing edge falsework made of UHPC at the boundary position of concrete slab, and welding anchor bar to the edge falsework to fix the edge falsework to the bottom falsework after casting the bottom falsework.

The present invention will become clearer in light of the following detailed description of illustrative embodiments of this invention described in connection with the drawings.

**Brief Description of the Drawings**

The present invention will be better understood by reference to the following detailed description and accompanying drawings, wherein:

Fig. 1 is an exploded perspective view showing a precast concrete falsework bubbledeck element according to the present invention;

Fig. 2 is a perspective view showing the precast concrete falsework bubbledeck element according to the present invention;

Fig. 3 is a cross-sectional view showing cross-section along A-A in Fig. 2;

Fig. 4 is a perspective view showing a precast concrete falsework bubbledeck element according to other embodiment of the present invention; and

Fig. 5 is a cross-sectional view showing cross-section along B-B in Fig. 4.

**Detailed description of the preferred embodiments**

Detailed embodiments of the present invention are disclosed herein. This

description is merely exemplary of principles of the invention but unrestricted to all principles. The scope of invention is clearly defined through hereby enclosed claims.

The first embodiment of the present invention is shown in Figs. 1, 2 and 3. According to the present embodiment, the precast concrete falsework bubbledeck element 100 includes: upper steel mesh sheet 110 consisting of many steel bars 111 connected with each other by welding to produce square mesh 112 with designed dimension 140 mm x 140 mm; lower steel mesh sheet 120 consisting of many steel bars 121 connected with each other by welding to produce square mesh 122 with the similar dimension as the mesh 112 of upper steel mesh sheet 110, the lower steel mesh sheet 120 is laid parallel with the upper steel mesh sheet 110; many oval hollow balls 130 with maximum diameter of 280 mm, in which each ball is fixed between respective meshes 112, 122 of upper and lower steel mesh sheets so that adjacent hollow balls will be contact with each other; reinforcement frames 140 spaced 0.7 m apart, including two parallel steel bars 141 along the length of bubbledeck element 100 with the distance between two steel bars 141 as same as the distance between two steel mesh sheets 110, 120, link steel bars 142 which are welded to steel bars 141 to fix them, reinforcement frames 140 are fixed between upper and lower steel mesh sheets 110, 120 in vertical direction by spot welding, thereby hollow balls 130 are tight fixed between upper and lower steel mesh sheets 110 and 120; many connectors 150 fixed to lower steel mesh sheet 120 at the positions spaced three meshs in each mesh row and in offset position in two adjacent mesh rows; and bottom falsework 160 made of UHPC with a depth of 10 mm to covered part of leg 152 of connector 150 so that bottom falsework 160 is fixed to lower steel mesh sheet 120 and separated a certain distance to lower steel mesh sheet 120.

As shown in the enlarged section in Fig. 1, the connector 150 includes a

body 151 and a leg 152 perpendicular to each other, in which the body 151 consists of a horizontal gap 1511 with the width equal to the diameter of the steel bars 121 of the lower steel mesh sheet 120 so that the horizontal gap 1511 engages with the steel bar 121 of the lower steel mesh sheet 120, and the leg 152 is buried in the UHPC layer of a bottom falsework 160, thereby the falsework 160 is fixed to the lower steel mesh sheet 120 with a certain distance.

As shown in Figs. 3 and 5, the lower steel mesh sheet 120 is not covered by concrete, but separated to the bottom falsework 160 with a certain distance by connector 150, thereby connecting between the lower steel mesh sheets 120 of the bubbledeck elements 100 before pouring concrete can be carried out easily and favourably controlled, permit directly connecting steel bars of lower steel mesh sheets 120 of adjacent bubbledeck elements 100 to ensure transmission capability for concrete slab better than the concrete slab in the patent DK172307B1. The bottom falsework 160 made of UHPC with 10 mm depth can significantly reduce the weight of the precast concrete falsework bubbledeck element 100. In addition, the bottom falsework 160 has high strength, greater load capacity, and better surface quality, thus it can be used for ceiling without render with mortar, and it is not need removing falsework after pouring concrete of slab as conventional formwork. Furthermore, it is very convenient to arrange the engineering design system such as power lines, communication cables or lights in the ceiling on or in this UHPC layer.

In this embodiment, the aggregates of UHPC for bottom falsework 160 comprise 50 to 60 wt% of a sand, 35 to 40 wt% of a cement, 3 wt% of a viscosity agent, 1 wt% of a ultra-small agent, in which diameter of aggregates are smaller than 1 mm.

According to present invention, by forming the square meshes 111, 121 of the upper and lower steel mesh sheets 110 and 120 with dimension of 140 mm x 140 mm, and using hollow balls 130 with 280 mm diameter, hollow balls 130

can contact with each other, thereby the volume of concrete for the hollow concrete slab can be reduced. Thus, it can reduce weight of the hollow concrete slab while ensuring the load capacity for concrete slab.

The second embodiment of the present invention relates to bubbledeck element at the boundary position of slab. As shown in Figs. 4 and 5, as similar to the precast concrete falsework bubbledeck element 100, a precast concrete falsework bubbledeck element 100' includes the upper steel mesh sheet 110 consisting of many steel bars 111 connected with each other by welding to produce square mesh 112 with designed dimension 140 mm x 140 mm; the lower steel mesh 120 consisting of many steel bars 121 connected with each other by welding to produce square mesh 122 with the same dimension as to the mesh 112 of upper steel mesh sheet 110 is laid parallel with the upper steel mesh sheet 110; many oval hollow balls 130 with diameter of 280 mm, in which each ball is fixed between respective meshes 112, 122 of upper and lower steel mesh sheets 110, 120 so that adjacent hollow balls will be contact with each other; reinforcement frames 140 spaced 0.7 m apart, including two parallel steel bars 141 along the length of bubbledeck element 100 with the distance between two steel bars 141 as same as the distance between two steel mesh sheets 110, 120, link steel bars 142 which are welded to steel bars 141 to fix them, reinforcement frames 140 are fixed between upper and lower steel mesh sheets 110, 120 in vertical direction by spot welding, thereby hollow balls 130 are tight fixed between upper and lower steel mesh sheets 110, 120; many connectors 150 fixed to lower steel mesh sheet 120 at the positions spaced three meshs in each mesh row and in offset position in two adjacent mesh rows; bottom falsework 160 made of UHPC with depth of 10 mm to covered part of leg 152 of the connector 150 so that bottom falsework 160 is fixed to lower steel mesh sheet 120 and separated a certain distance to lower steel mesh sheet 120; and edge falsework 170 made of UHPC with depth of 20 mm, which its height is equal to the thickness of the concrete slab, is one piece monolithic cast with and

perpendicular to the bottom falsework 160.

In this embodiment, ends of anchor bar 180 are buried in UHPC layer of bottom falsework 160 and the edge falsework 170, thereby reinforcing for the bottom falsework 160 and the edge falsework 170.

In the present invention, the edge falsework 170 used to replace formwork at the boundary position of concrete slab, thus, decrease in labor force and subsidiary material as formwork when casting concrete slab, as well as saving time and increase in worker efficiency.

According to another embodiment, the process of manufacturing the precast concrete falsework bubbledeck element 100 comprising the steps: (i) placing the lower steel mesh sheet 120 at the designed position; (ii) welding the reinforcement frames 140 to the lower steel mesh sheet 120 at the designed positions in vertical direction; (iii) putting hollow balls 130 on meshes 122 of the lower steel mesh sheet 120, in which the hollow balls 130 are separated by one mesh in horizontal and vertical direction; (iv) placing the upper steel mesh sheet 110 onto hollow balls 130 and connecting it to the reinforcement frames 140 by welding; (v) fixing connectors 150 to steel bars 121 of the lower steel mesh sheet 120; (vi) casting the bottom falsework 160 by crane the structure element including hollow balls 130 fixed between the upper and lower steel mesh sheets 110, 120 into the mold having liquid UHPC layer with depth of 10 mm so that this layer covered a part of leg 152 of connectors 150; and (vii) curing the concrete bottom falsework in saturated steam, removing the mold, and natural moist curing.

In the embodiment, before casting step the bottom falsework 160 of bubbledeck element 100' can further include placing edge falsework 170 made of UHPC at the boundary position of slab, and welding anchor bar 180 to the edge falsework 170 to fix the edge falsework 170 to the bottom falsework 160

after casting the bottom falsework.

**Advantageous effects**

Thanks to using the bottom falsework made of UHPC is manufactured in the factory, the bottom falsework has high strength, better surface quality, strong for lift by crane, without removing the formwork, thus, saving labor force and time for remove formwork and ceiling plastering on construction site;

According to present invention, the bubbledeck element using the bottom falsework with 10-12 mm depth, its depth much thinner than depth of concrete layer is 60 mm of the bubbledeck element in the patent DK172307B1, thereby significantly reduction in weight of bubbledeck element, easily transport and lifting by crane. Furthermore, the bottom falsework is separated to the lower steel mesh sheet, thereby connection welding to steel bars of lower steel mesh sheets between adjacent bubbledeck elements can be performed and controlled easily before pouring concrete of slab, and ensure good reinforcement between the lower steel mesh sheets in bidirectional;

Due hollow balls are arranged in contact with each other, thereby volume of concrete for the hollow concrete slab can be reduced, thus, it can reduce weight of the hollow concrete slab while ensuring the load capacity for slab;

Due edge falsework is one piece monolithic cast with the bottom falsework at the boundary position of concrete slab, and its height is equal to the thickness of the concrete slab, thus, it is not need install formworks at the boundary position of slab before casting concrete for hollow concrete slab, saving labor force and time on construction site;

Thanks to bubbledeck elements is manufactured in the factory, recovering the situation of installing on the high floors and that of the pouring floors with thousands of square meters as well as reducing the time of moving by the

workers on the high floors and bringing about the higher efficiency and reduce construction time.

Although the invention has been described with reference to specific embodiments and figures attached but it is to be understood that the presently disclosed and claimed inventive is not limited in those embodiments. Various modifications or variations can be made for a skilled person in the art based on the above description, for example, the meshes of the upper and lower steel mesh sheets is rectangular with designed dimension, hollow balls can be replaced by the frustum of pyramid blocks with square or rectangular bottom and curved edges. Therefore, the scope of invention includes other equivalent variations and modifications defined in the following claims.

## Claims

1. A precast concrete falsework bubbledeck element, includes:

upper steel mesh sheet (110) consisting of many steel bars (111) which are connected with each other by welding or joining to produce square mesh (112) with a designed dimension;

lower steel mesh sheet (120) consisting of many steel bars (121) which are connected with each other by welding or joining to produce square mesh (122) with designed dimension that similar to the mesh (112) of upper steel mesh sheet (110), the lower steel mesh sheet (120) is laid in parallel with upper steel mesh sheet (110);

many hollow balls (130) of spherical or oval shapes, in which each ball shall be fixed between respective meshes (112, 122) of upper steel mesh sheet (110) and lower steel mesh sheet (120) so that adjacent hollow balls (130) will be contact with each other;

reinforcement frames (140) are spaced, preferably 0.7 m, along the length of bubbledeck elements, and fixed between the upper (110) and lower steel mesh sheets (120) in vertical direction by spot welding, thereby hollow balls (130) are tight fixed between the upper (110) and lower steel mesh sheets (120);

many connectors (150) fixed to the lower steel mesh sheet (120) at the optionally positions depending on the actual conditions during manufacturing in each direction; and

bottom falsework (160) made of Ultra High Performance Concrete (UHPC) with 10-12 mm depth, so that the bottom falsework (160) covers a part of leg (152) of connector (150) to be fixed to the lower steel mesh sheet (120) but separates a certain distance from the lower steel mesh sheet (120), thereby connection welding the steel bars (121) of lower steel mesh sheet (120) between

two adjacent bubbledeck elements (100) may be performed and controlled easily, and ensure the good reinforcement between the lower steel mesh sheets (120) in bidirectional.

2. The precast concrete falsework bubbledeck element as claimed in claim 1, wherein connector (150) includes a body (151) and leg (152) perpendicular to each other, in which the body (151) consisting of horizontal gap (1511) with the width is equal to the diameter of the steel bars (121) of the lower steel mesh sheet (120), the leg (152) is buried in UHPC layer of bottom falsework (160).

3. The precast concrete falsework bubbledeck element as claimed in claim 2, further include edge falsework (170), which its height is equal to the thickness of the concrete slab, is one piece monolithic cast with and perpendicular to the bottom falsework (160), and is fixed to bottom falsework (160) by anchor bar (180), cable anchor holes are formed at the edge falsework (170) to permit the post-tensioning cables placed in concrete slab.

4. The precast concrete falsework bubbledeck element as claimed in claim 1, wherein meshes (112, 122) of the upper (110) and lower steel mesh sheets (120) is square or rectangular with designed dimension.

5. The precast concrete falsework bubbledeck element as claimed in claim 1, hollow balls (130) can be replaced by the frustum of pyramid blocks with square or rectangular bottom and curved edges.

6. The precast concrete falsework bubbledeck element as claimed in claim 1, wherein the reinforcement frame (140) is structured in form of strip rectangular mesh, including two steel bars (141), which are arranged in parallel, and link steel bars (142), which are fixed to two steel bars (141) in horizontal and oblique direction, in which the distance between two steel bars (141) is the same the distance between two steel mesh sheets (110, 120).

7. A process of manufacturing the precast concrete falsework bubbledeck element, comprising the steps:

(i) placing the lower steel mesh sheet (120) at the designed position;

(ii) welding the reinforcement frames (140) to the lower steel mesh sheet (120) at the designed positions in vertical direction;

(iii) putting the hollow balls (130) on meshes (122) of the lower steel mesh sheet (120), in which the hollow balls (130) are separated by one mesh in horizontal and vertical direction;

(iv) placing the upper steel mesh sheet (110) onto hollow balls (130) and connected to the reinforcement frames (140) by welding;

(v) fixing connectors (150) to steel bars (121) of the lower steel mesh sheet (120);

(vi) casting the bottom falsework (160) by crane the structure element including hollow balls (130) fixed between the upper (110) and lower steel meshes (120) into the mold having liquid UHPC layer with depth of 10-12 mm so that this layer covered a part of leg (152) of connectors (150); and

(vii) curing the concrete bottom falsework in saturated steam, removing the mold, and natural moist curing.

8. The process of manufacturing the precast concrete falsework bubbledeck element as claimes in claim 7, wherein before casting step the bottom falsework (160) of bubbledeck element (100') can further include placing edge falsework (170) made of UHPC at the boundary position of concrete slab, and welding anchor bar (180) to the edge falsework (170) to fix the edge falsework (170) to the bottom falsework (160) after casting the bottom falsework (160).

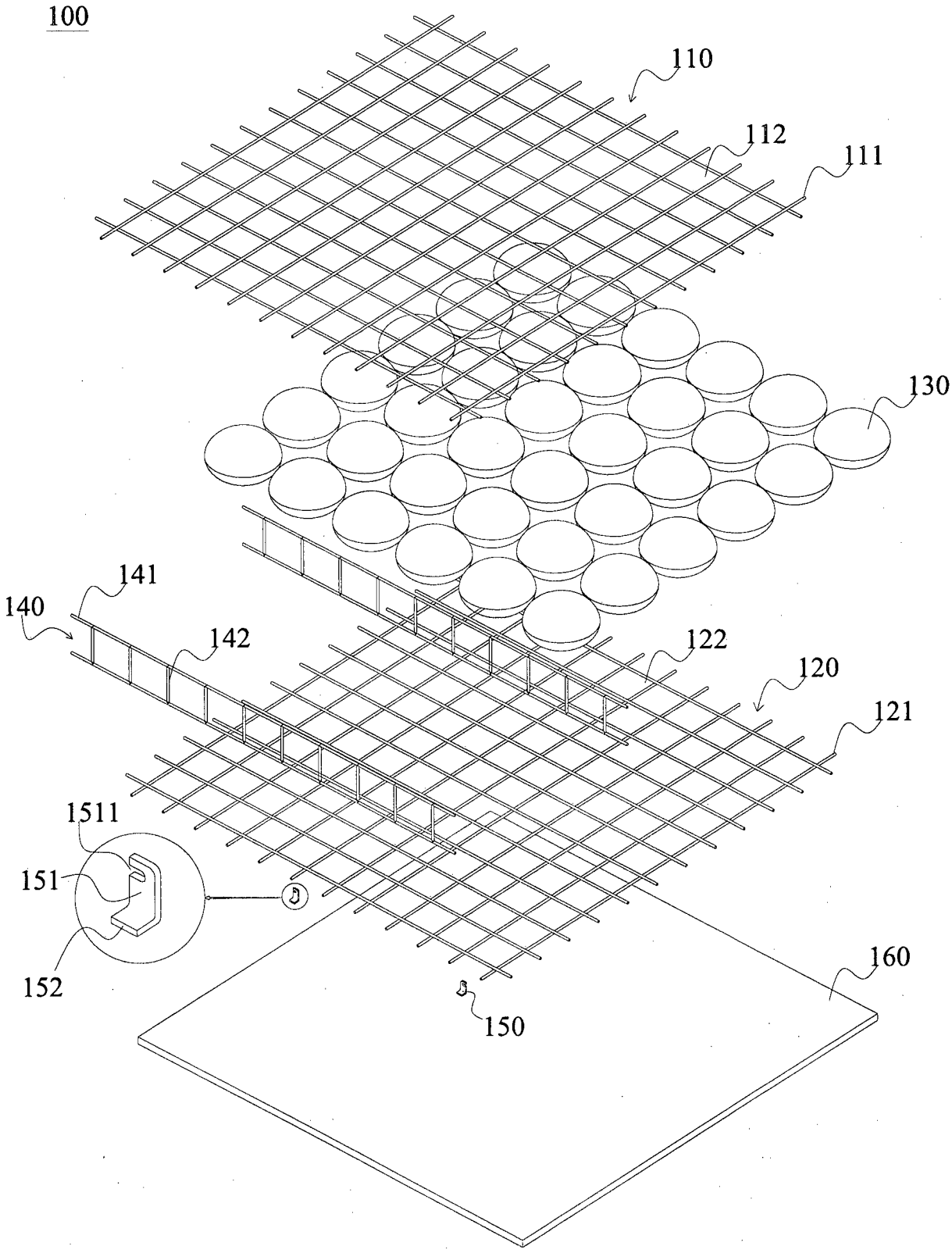


Fig.1

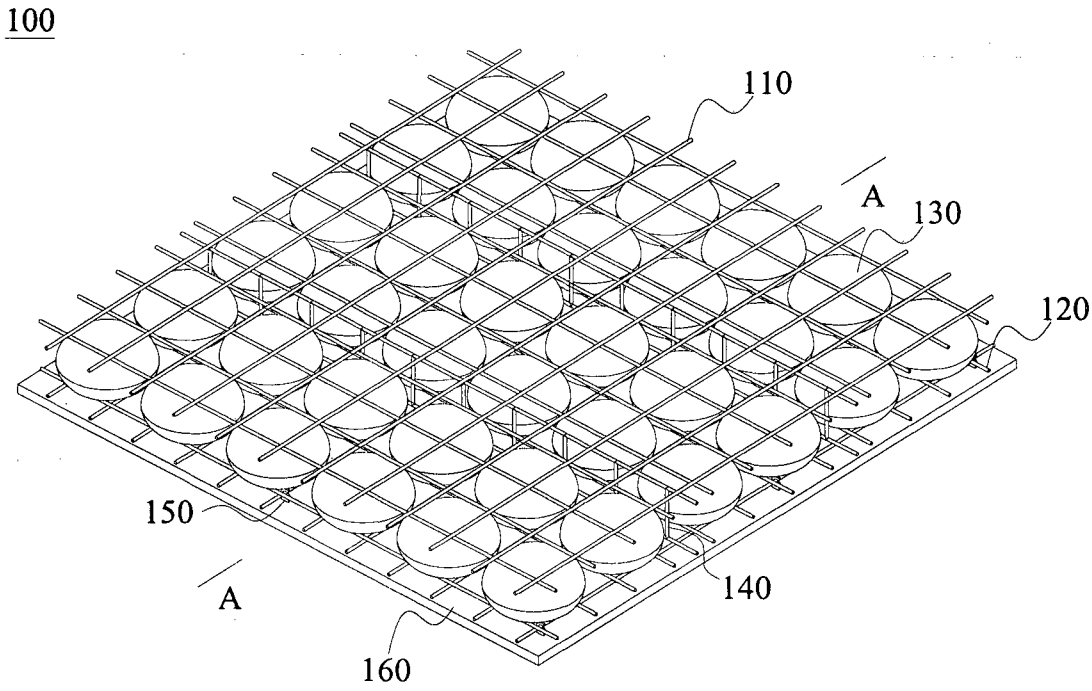
100
110
A
130
120
150
A
140
160

Fig.2

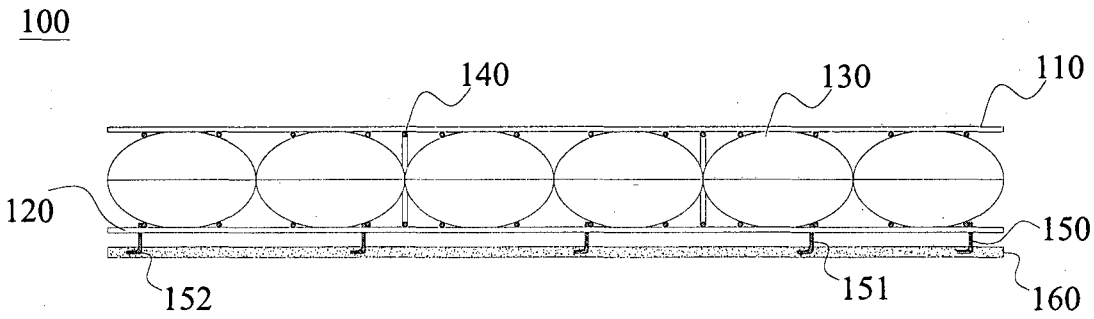
100
140
130
110
120
150
152
151
160

Fig.3

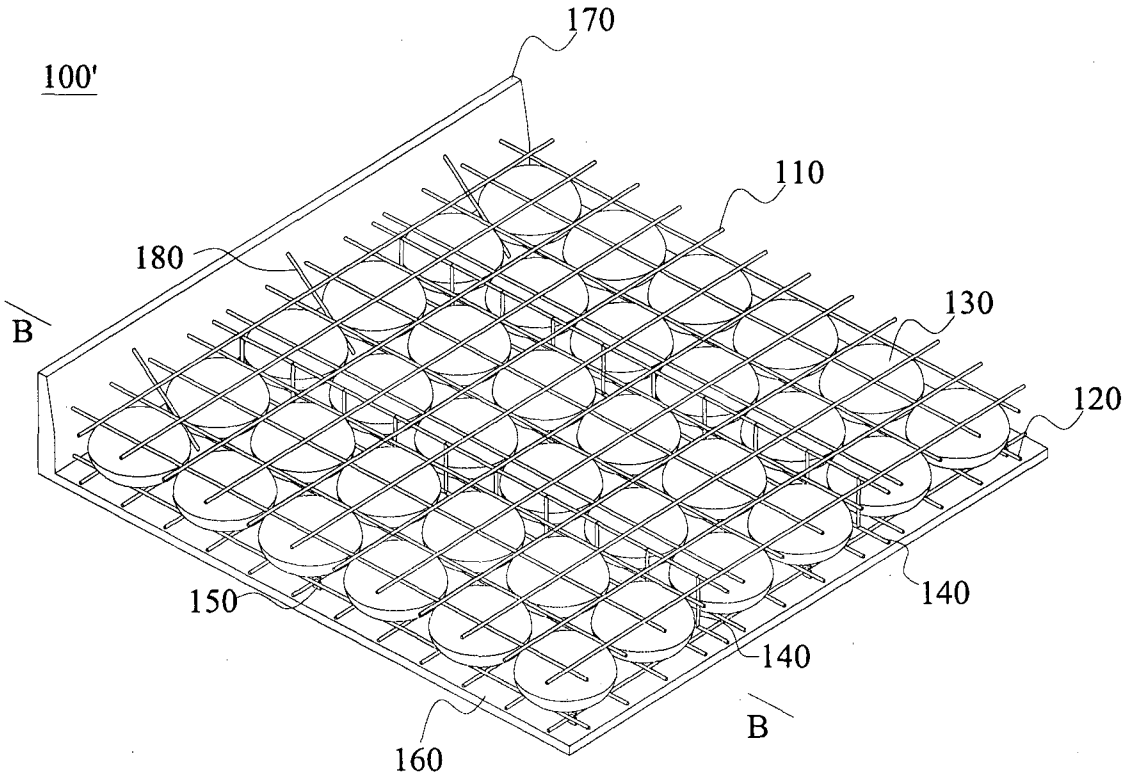
170
100'
110
180
130
B
120
140
150
140
B
160

Fig.4

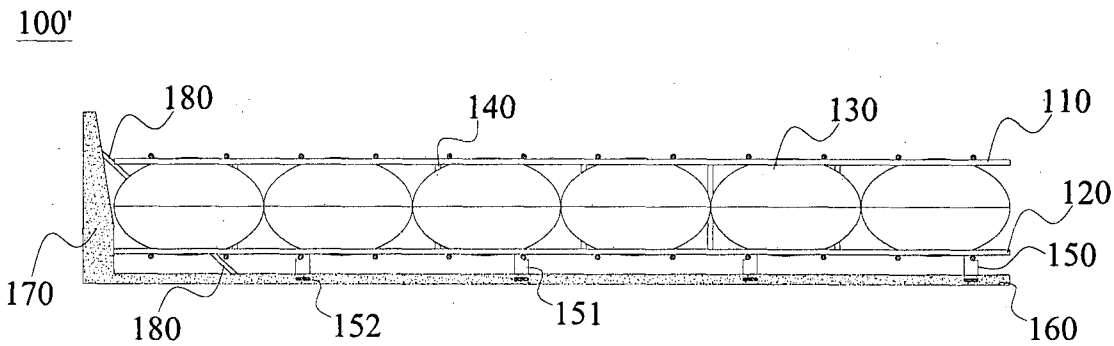
100'
180
140
130
110
120
150
170
180
152
151
160

Fig.5

# INTERNATIONAL SEARCH REPORT

International application No.

PCT / VN 2015/000006

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***E04B 5/32*** (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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)

WPI, EPODOC, TXTnn

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | JP 2002339493 A (PENTA OCEAN CONSTR CO LTD) 27 November 2002 (27.11.2002)<br>entire document | 1-8 |
| X | WO 2010132900 A1 (DO, DUC THANG) 18 November 2010 (18.11.2010)<br>entire document | 1-8 |
| X | WO 2014058308 A1 (BARHOLD B.V) 17 April 2014 (17.04.2014)<br>entire document | 1-8 |

☐ 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 | Date of mailing of the international search report |
|---|---|
| 21 September 2015 (21.09.2015) | 30 September 2015 (30.09.2015) |
| Name and mailing address of the ISA/AT<br>Austrian Patent Office<br>Dresdner Straße 87, A-1200 Vienna<br>Facsimile No. +43 / 1 / 534 24-535 | Authorized officer<br>WAGNER S.<br>Telephone No. +43 / 1 / 534 24-381 |

**INTERNATIONAL SEARCH REPORT**
Information on patent family members

International application No.
PCT / VN 2015/000006

| Patent document cited in search report | | | Patent family member(s) | | | Publication date |
|---|---|---|---|---|---|---|
| JP | A | 2002339493 | JP | A | 2002339493 | 2002-11-27 |
| WO | A1 | 2010132900 | CN | A | 102449248 | 2012-05-09 |
| | | | WO | A1 | 2010132900 | 2010-11-18 |
| WO | A1 | 2014058308 | EP | A1 | 2906761 | 2015-08-19 |
| | | | NL | C | 2009607 | 2014-04-14 |
| | | | WO | A1 | 2014058308 | 2014-04-17 |