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(54) **A LOWER PART OF A BUILDING AND A METHOD OF ERECTING SUCH LOWER PART OF A BUILDING**

(57) Herein is disclosed a lower part of a building (1) comprising a base frame (6) made from steel beams (7), a point foundation (2) comprising a plurality of load-bearing points, a plurality of load-bearing distance piece (3) arranged on a lower side of the base frame (6) for supporting the base frame (6) on the plurality of load-bearing points of the point foundation (2), wherein the distance pieces (3) each are of a vertical extend of more than 50 millimetre downwards from the lower side of the base frame (6), such as in the range of 50 to 200 millimetres, the distance pieces (3) having an average thermal conductivity over their vertical extend of less than 0.6 W/(m K), such as less than 0.5 W/(m K), and wherein each distance piece (3) is of a compression strength sufficient to support a vertical load of at least 2 metric ton, such as at least 5 metric ton. Further is disclosed a method of erecting such lower part of a building.

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## Description

**[0001]** The present invention relates to a lower part of a building comprising a point foundation as well as a method of erecting such lower part of a building.

## BACKGROUND

**[0002]** It is well known in the art to erect buildings on point foundations, such as screw piles and other types of piles. In particular lighter buildings are provided with a lower part of the building that comprises a wooden frame supported on the point foundations. However, due to the requirement of keeping such wooden frame dry and protected from humidity from the ground underneath the building, a ventilation space should be provided between the ground and the wooden frame, which adds to the total height of the building from the ground level.

**[0003]** It is an object of the present invention to provide a lower part of a building supported on a point foundation which provides for a reduced height of the building from the ground level as well as a method for erecting such lower part of a building.

## BRIEF DESCRIPTION OF THE INVENTION

**[0004]** By the present invention is provided a lower part of a building supported on a point foundation, comprising a frame made from steel beams, which frame is supported on the point foundation. The frame of steel beams may be situated directly on or just above the ground since the steel beams are not susceptible to rot and decay due to moisture raising from the ground. In order to avoid a thermal bridge from the point foundation to the frame made from steel beams, which may cause heat losses from the building as well as condensation of moisture within the frame, thermally isolating distance pieces are situated between the point foundations and the frame of steel beams. Hereby, a lower part of a building supported on a point foundation is provided which allows for a reduced height of the building from the ground level.

**[0005]** The thermal bridge is not a problem when a wooden frame is used, since the thermal conductivity of wood is much lower than that of steel.

**[0006]** Thus, by the present invention is provided a lower part of a building comprising a base frame made from steel beams, a point foundation comprising a plurality of load-bearing points, a plurality of load-bearing distance piece arranged on a lower side of the base frame for supporting the base frame on the plurality of load-bearing points of the point foundation, wherein the distance pieces each are of a vertical extend of more than 50 millimetre downwards from the lower side of the base frame, such as in the range of 50 to 200 millimetres, the distance pieces having an average thermal conductivity over their vertical extend of less than 0.6 W/(m K), such as less than 0.5 W/(m K), and wherein each distance piece is of a compression strength sufficient to support a vertical

load of at least 2 metric ton, such as at least 5 metric ton.

**[0007]** It is furthermore preferred that the lower part of the building comprises a layer of a thermally insulating material provided below the base frame, wherein openings are provided in the thermally insulating material for accommodating the distance pieces, which extends through at least a part of the layer of a thermally insulating material. The layer of the thermally insulating material extends vertically at least 50 millimetres, such as at least 100 millimetres.

**[0008]** In a further preferred embodiment, the layer of thermally insulating material comprises two horizontal sublayers of thermally insulating material and the lower part of the building further comprises a membrane of a radon protection barrier extending horizontally beneath an upper sublayer of thermally insulating material and above a lower sublayer of thermally insulating material, wherein the distance pieces each comprises two horizontal subpieces, of which the upper subpiece is of a vertical extend corresponding to the vertical extend of the upper sublayer of thermally insulating material, and wherein the membrane of a radon protection barrier extends horizontally between the two subpieces of the distance pieces.

**[0009]** The distance piece being divided into two horizontal subpieces provides for the positioning of the radon protection barrier substantially completely across the whole of the lower part of the building and protected between the two horizontal sublayers of thermally insulating material.

**[0010]** The layer of thermally insulating material comprises preferably glass foam, either the lower subpiece alone or both subpieces. Glass foam has a low thermal conductivity and a high resistance to transmission of humidity, and is suitable for acting as a vapour barrier towards the ground.

**[0011]** The distance pieces are preferably made from a polyethylene or a polyamide, such as a fibre-reinforced polyamide, but other suitable materials, such as High-Density Polyethylene or Poly Vinyl Chloride (PVC) could also be used.

**[0012]** The point foundation comprises preferably a plurality of screw piles extending into the ground, which is a low-cost solution in installation of a point foundation.

**[0013]** The present invention also relates to a method of erecting a lower part of a building, the method comprising the steps of driving a plurality of point foundation elements into the ground, arranging a distance pieces on top of each point foundation element, the distance pieces being of a vertical extend of more than 50 millimetre, such as in the range of 50 to 200 millimetres, and having an average thermal conductivity over their vertical extend of less than 0.6 W/(m K), such as less than 0.5 W/(m K), and wherein each distance piece is of a compression strength sufficient to support a vertical load of at least 2 metric ton, such as at least 5 metric ton, arranging a base frame made from steel beams on top of the distance pieces so that the base frame is supported

by the distance pieces, and securing the base frame to at least some of the point foundation elements.

**[0014]** The method may further comprise the step of providing a layer of a thermally insulating material below the base frame, wherein openings are provided in the thermally insulating material for accommodating the distance pieces, so that the distance pieces extend through at least a part of the layer of a thermally insulating material.

**[0015]** The layer of the thermally insulating material may preferably extend vertically at least 50 millimetres, such as at least 100 millimetres.

**[0016]** The method may further comprising the steps of arranging a lower horizontal sublayer of the layer of thermally insulating material on top of the head part of the plurality of point foundation elements, arranging a membrane of a radon protection barrier horizontally on top of the lower horizontal sublayer of the layer of thermally insulating material, and arranging an upper horizontal sublayer of the layer of thermally insulating material on top of the membrane of a radon protection barrier, wherein the distance pieces each comprises two horizontal subpieces, and wherein the membrane of a radon protection barrier extends horizontally between the two subpieces of each of the distance pieces.

**[0017]** The upper subpiece of each distance piece is preferably of a vertical extend corresponding to the vertical extend of the upper sublayer of thermally insulating material.

#### BRIEF DESCRIPTION OF THE FIGURES

**[0018]** An examples of the present invention is shown in the figures of which

Fig. 1 is a cross section of the lower part of a building according to the present invention,

Fig. 2 is a perspective view of a point foundation with a distance piece and a fastening bracket,

Fig. 3 is a first step of the construction of the lower part of a building of fig. 1,

Fig. 4 is a second step of the construction of the lower part of a building of fig. 1,

Fig. 5 is a third step of the construction of the lower part of a building of fig. 1, and

Fig. 6 is a fourth step of the construction of the lower part of a building of fig. 1,

#### DETAILED DESCRIPTION OF THE EXAMPLE

**[0019]** The lower part 1 of the building is shown in cross-section Fig. 1, comprising a point foundation 2, a distance piece 3 comprising a lower subpiece 4 and an upper subpiece 5, a base frame 6 made from steel beams 7, an upper sublayer of thermally insulating material 8, a lower sublayer of thermally insulating material 9, a membrane of a radon protection barrier 10, a side layer of thermally insulating material 11, a bracket 12 fastened

to the point foundation 2 by means of a bolt 13, frame-filling thermally insulating material 14 and a stamped sand filling 15.

**[0020]** The point foundations 2 are preferably screw piles, which are easy to install, but other types of point foundations, such as piles driven into the ground or cast in situ in a hole in the ground could be used. The distance piece 3 is made from a material having a relatively low average thermal conductivity over their vertical extend of less than 0.6 W/(m K), such as less than 0.5 W/(m K) and which is stable in the environment and has a suitable compression strength, preferably sufficient to support a vertical load of at least 2 metric ton, such as at least 5 metric ton. Suitable materials are polyethylene and a fibre-reinforced polyamide, another possible material is High-Density Polyethylene or Poly Vinyl Chloride (PVC).

**[0021]** At least some of the thermally insulating material 8, 9, 11, 14 is preferably glass foam, which has a low thermal conductivity and a high resistance to transmission of humidity and is suitable for being placed on or near the sand 15.

**[0022]** The point foundation 2 is shown in Fig. 2 with a distance piece 3 comprising lower 4 and upper 5 subpieces and the fastening bracket 12 fastened with the bolt 13.

**[0023]** The erection of such building is illustrated in Figs. 3 to 6 and starts with the positioning of the point foundations 2 into the ground. Then a layer of stamped sand 15 is laid out between and around the point foundations 2 so that the upper surface of the sand 15 is level with the top of the point foundations 2. The lower subpieces 4 of the distance pieces 3 are placed on top of the point foundations 2 and the lower sublayer of thermally insulating material 9 is provided with cut-outs for accommodating the lower subpieces 4 of the distance pieces 3 and is placed on top of the sand 15. The radon protection barrier 10 is then placed on top of the lower sublayer of thermally insulating material 9 and the lower subpieces 4, and the upper subpieces 5 are positioned on top of the radon protection barrier 10 as shown in Fig. 3.

**[0024]** Next is the upper sublayer of thermally insulating material 8 likewise provided with cut-outs for accommodating the upper subpieces 5 of the distance pieces 3 and is placed on top of the radon protection barrier 10 and the fastening brackets 12 are fastened with the bolts 13 to the point foundations 2 as shown in Fig. 4.

**[0025]** Now the base frame made 6 from steel beams 7 and filled with the frame-filling thermally insulating material 14 is placed on top of the upper subpieces 5 and the upper sublayer of thermally insulating material 8 and is fastened to the brackets 12 as shown in Fig. 5. Finally, the side layer of thermally insulating material 11 is fastened to the sides of the base frame 6 as shown in Fig. 6 and the remaining part of the building can be erected.

**[0026]** The side layer of thermally insulating material 11 may be provided with an outer layer of e.g. hydraulic mortar or fibre-reinforced cement plates to protect the

insulating material 11.

**[0027]** More stamped sand 15 may be added around the lower part of the building 1 as shown in Fig. 1, where the side layer of thermally insulating material 11 is partly buried in the sand 15. Alternatively or additionally to sand 15, a paving of cement slabs or a layer of capillary-breaking material, such as pebbles, may be applied, or a layer of topsoil can be placed for providing a fertile ground for grass etc.

#### LIST OF REFERENCE NUMERALS

##### **[0028]**

- |    |                                                 |
|----|-------------------------------------------------|
| 1  | Lower part of building                          |
| 2  | Point foundation                                |
| 3  | Distance piece                                  |
| 4  | Lower subpiece of distance piece                |
| 5  | Upper subpiece of distance piece                |
| 6  | Base frame                                      |
| 7  | Steel beams                                     |
| 8  | Upper sublayer of thermally insulating material |
| 9  | Lower sublayer of thermally insulating material |
| 10 | Membrane of a radon protection barrier          |
| 11 | Side layer of thermally insulating material     |
| 12 | Bracket fastened                                |
| 13 | Bolt                                            |
| 14 | Frame-filling thermally insulating material     |
| 15 | Stamped sand filling                            |

#### Claims

##### 1. A lower part of a building (1) comprising

a base frame (6) made from steel beams (7),  
a point foundation (2) comprising a plurality of load-bearing points,  
a plurality of load-bearing distance piece (3) arranged on a lower side of the base frame (6) for supporting the base frame (6) on the plurality of load-bearing points of the point foundation (2),

wherein the distance pieces (3) each are of a vertical extend of more than 50 millimetre downwards from the lower side of the base frame (6), such as in the range of 50 to 200 millimetres, the distance pieces (3) having an average thermal conductivity over their vertical extend of less than 0.6 W/(m K), such as less than 0.5 W/(m·K), and wherein each distance piece (3) is of a compression strength sufficient to support a vertical load of at least 2 metric ton, such as at least 5 metric ton.

##### 2. The lower part of a building (1) of claim 1 comprising a layer of a thermally insulating material (8, 9) provided below the base frame (6), wherein openings are provided in the thermally insulating material (8,

9) for accommodating the distance pieces (3), which extends through at least a part of the layer of a thermally insulating material (8, 9).

##### 3. The lower part of a building (1) according to claim 3, wherein the layer of the thermally insulating material (8, 9) extends vertically at least 50 millimetres, such as at least 100 millimetres.

##### 4. The lower part of a building (1) according to claim 2 or 3, wherein the layer of thermally insulating material (8, 9) comprises two horizontal sublayers (8, 9) of thermally insulating material (8, 9) and the lower part of the building (1) further comprises a membrane 10 of a radon protection barrier extending horizontally beneath an upper sublayer 8 of thermally insulating material and above a lower sublayer 9 of thermally insulating material, wherein the distance pieces (3) each comprises two horizontal subpieces (4, 5), of which the upper subpiece (5) is of a vertical extend corresponding to the vertical extend of the upper sublayer (8) of thermally insulating material, and wherein the membrane (10) of a radon protection barrier extends horizontally between the two subpieces (4, 5) of the distance pieces (3).

##### 5. The lower part of a building (1) according to any of the preceding claims, wherein the point foundation (2) comprises a plurality of screw piles extending into the ground.

##### 6. A method of erecting a lower part of a building (1), the method comprising the steps of

driving a plurality of point foundation elements (2) into the ground,  
arranging a distance pieces (3) on top of each point foundation element (2), the distance pieces (3) being of a vertical extend of more than 50 millimetre, such as in the range of 50 to 200 millimetres, and having an average thermal conductivity over their vertical extend of less than 0.6 W/(m K), such as less than 0.5 W/(m·K), and wherein each distance piece (3) is of a compression strength sufficient to support a vertical load of at least 2 metric ton, such as at least 5 metric ton,  
arranging a base frame (6) made from steel beams (7) on top of the distance pieces (3) so that the base frame (6) is supported by the distance pieces (3), and  
securing the base frame (6) to at least some of the point foundation elements (2).

##### 7. The method according to claim 6, further comprising the step of providing a layer of a thermally insulating material (8, 9) below the base frame (6), wherein openings are provided in the thermally insulating ma-

terial (8, 9) for accommodating the distance pieces (3), so that the distance pieces (3) extends through at least a part of the layer of a thermally insulating material (8, 9).

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8. The method according to claim 7, wherein the layer of the thermally insulating material (8, 9) extends vertically at least 50 millimetres, such as at least 100 millimetres.

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9. The method according to claim 7 or 8, further comprising the steps of

arranging a lower horizontal sublayer (9) of the layer of thermally insulating material on top of the head part of the plurality of point foundation elements (2),

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arranging a membrane (10) of a radon protection barrier horizontally on top of the lower horizontal sublayer (9) of the layer of thermally insulating material, and

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arranging an upper horizontal sublayer (8) of the layer of thermally insulating material on top of the membrane (10) of a radon protection barrier,

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wherein the distance pieces (3) each comprises two horizontal subpieces (4, 5), and wherein the membrane (10) of a radon protection barrier extends horizontally between the two subpieces (4, 5) of each of the distance pieces (3).

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10. The method according to claim 9, wherein the upper subpiece (5) of each distance piece (3) is of a vertical extend corresponding to the vertical extend of the upper sublayer (8) of thermally insulating material.

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11. The method according to any of claims 6 to 10, wherein the point foundation (2) comprises a plurality of screw piles extending into the ground.

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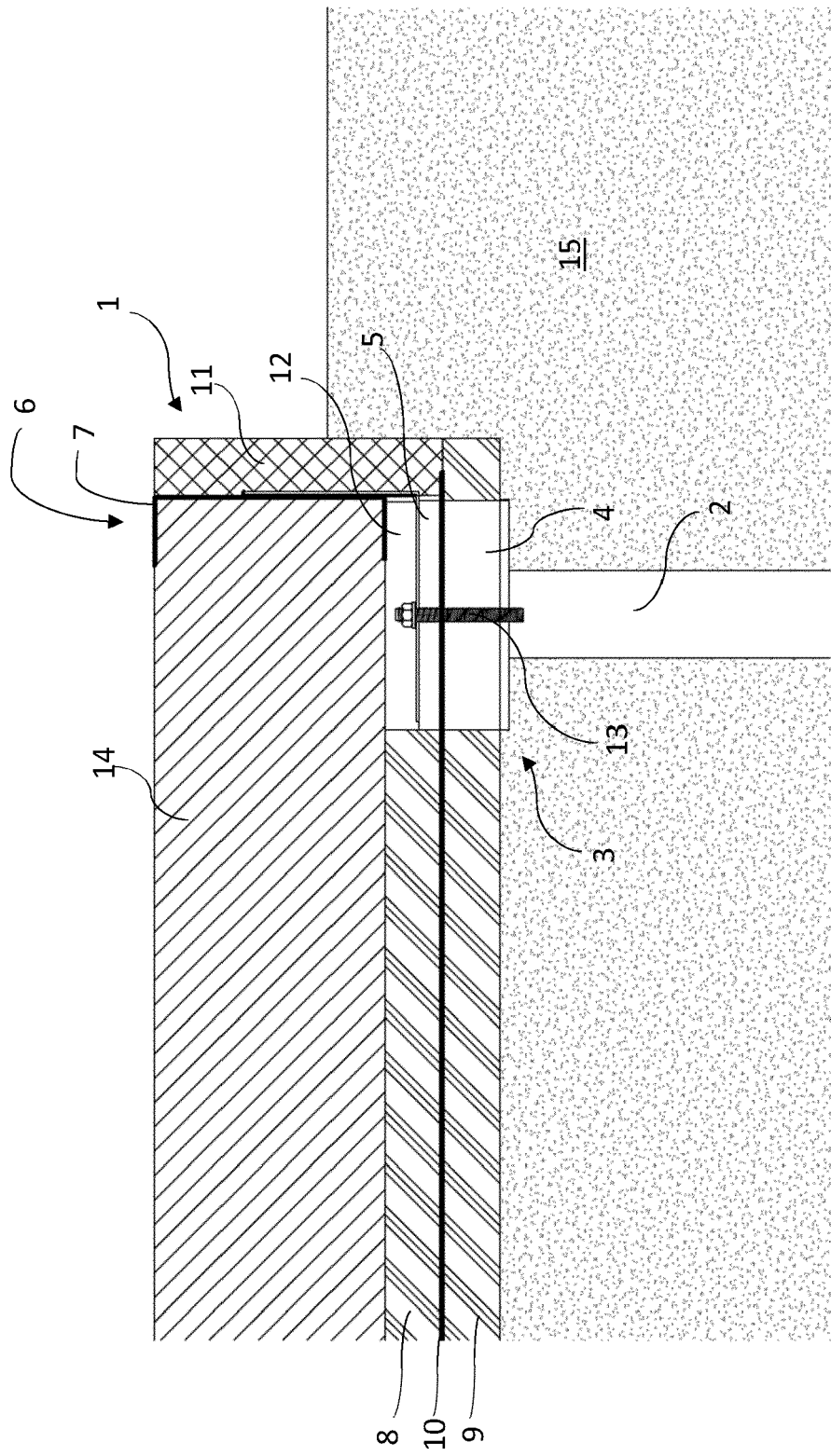


Fig. 1

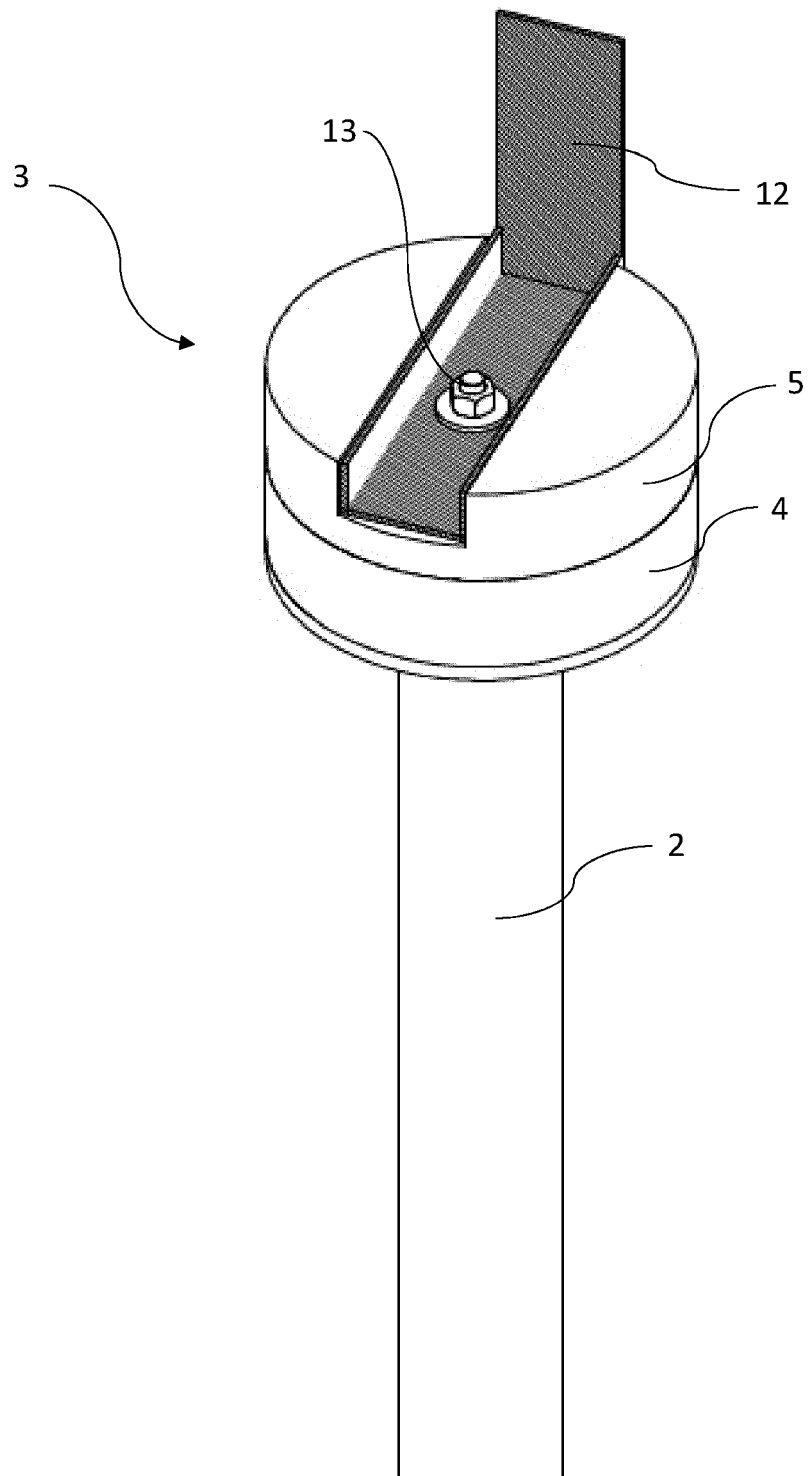
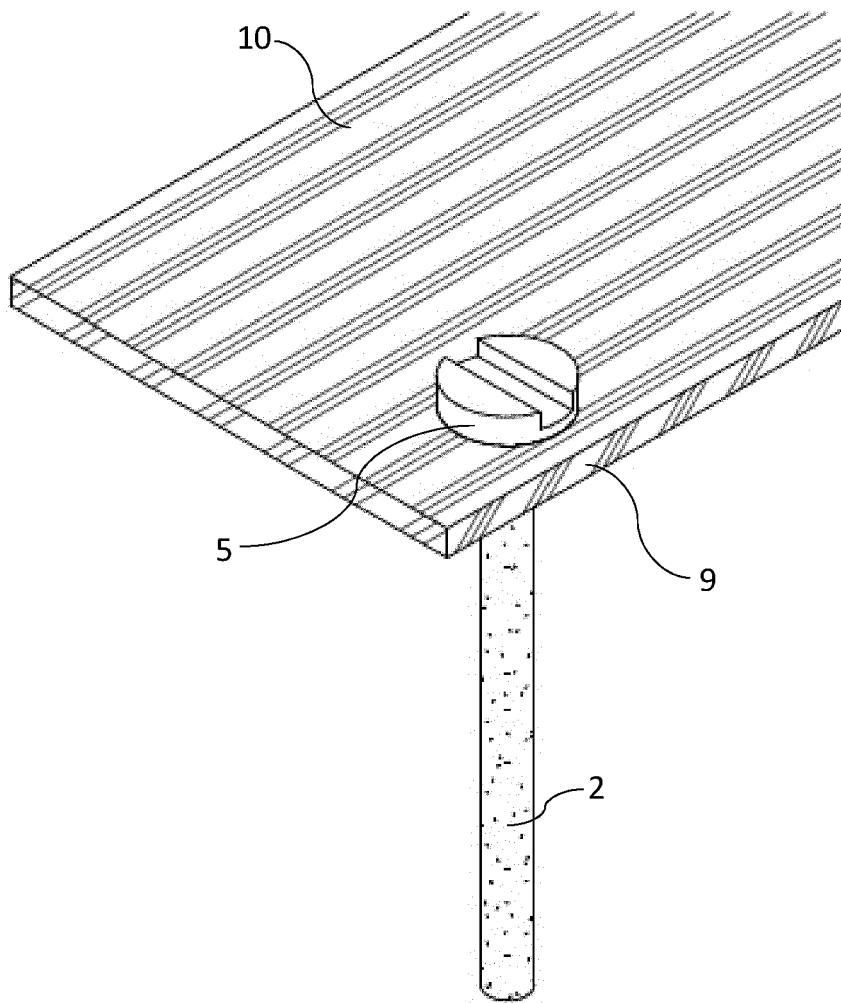


Fig. 2



**Fig. 3**

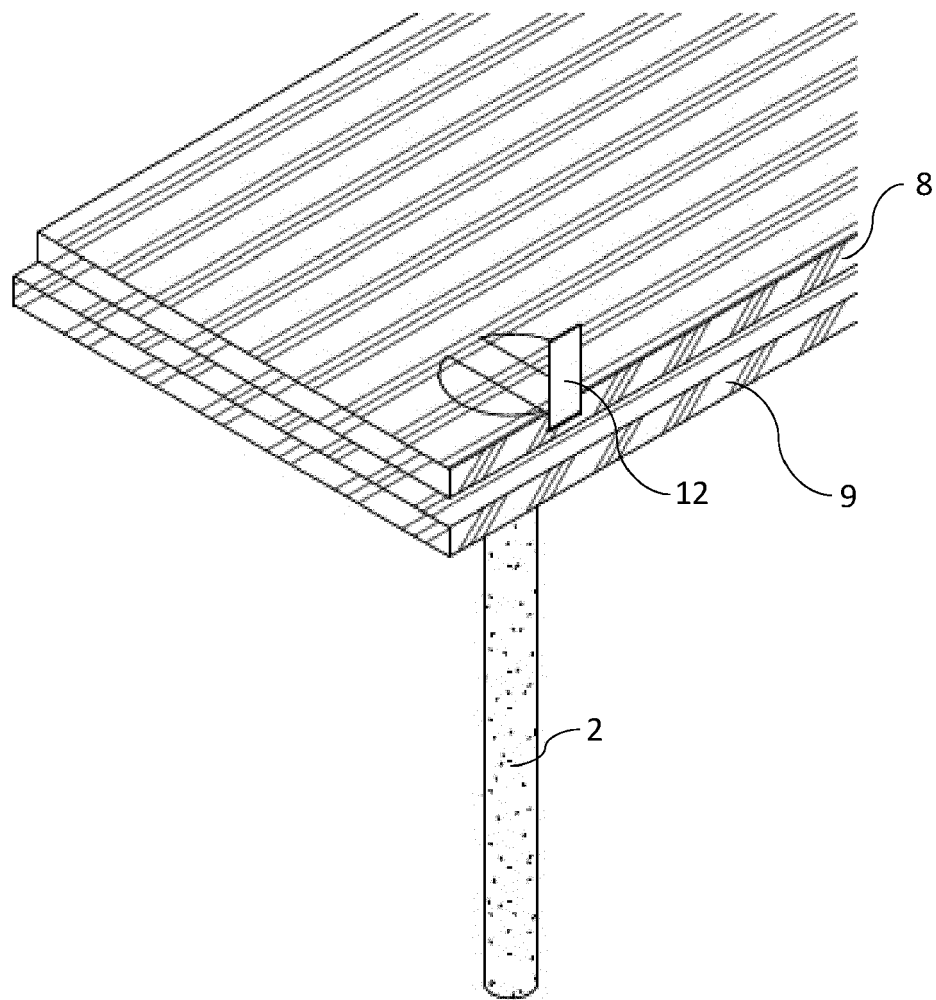
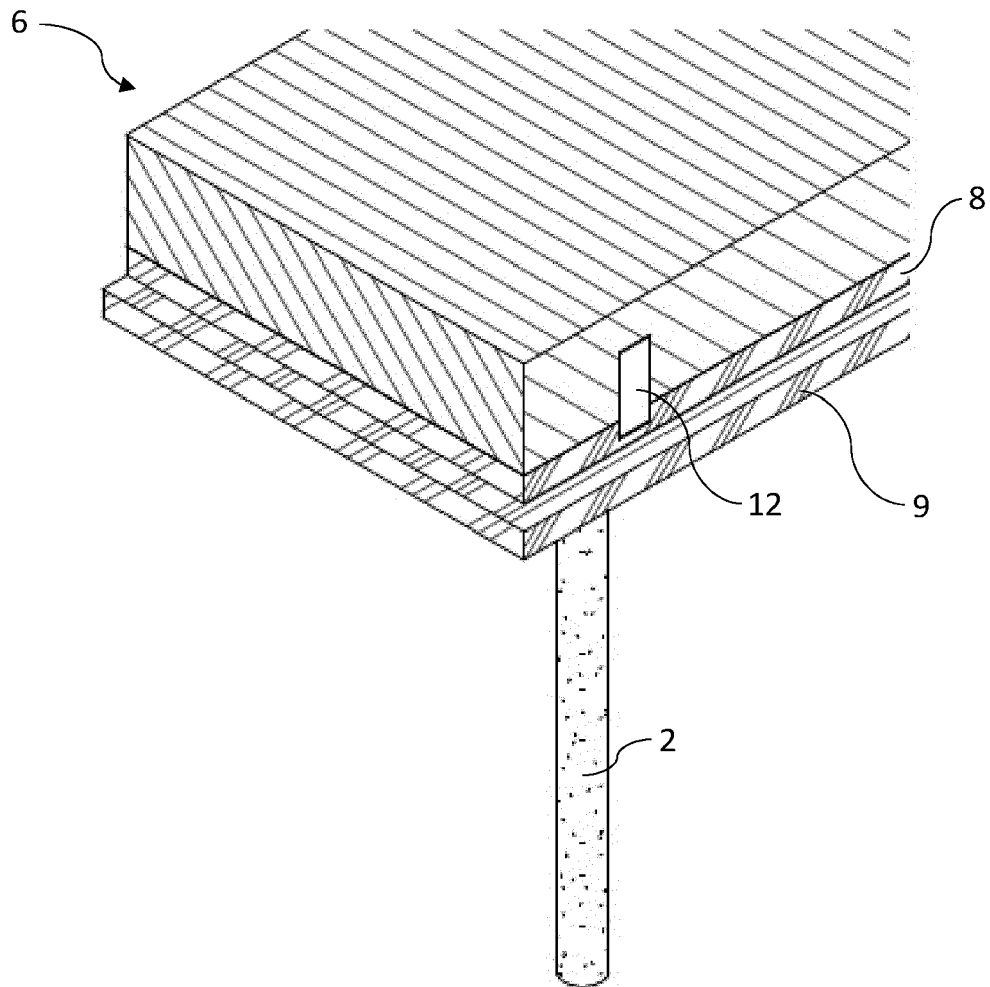
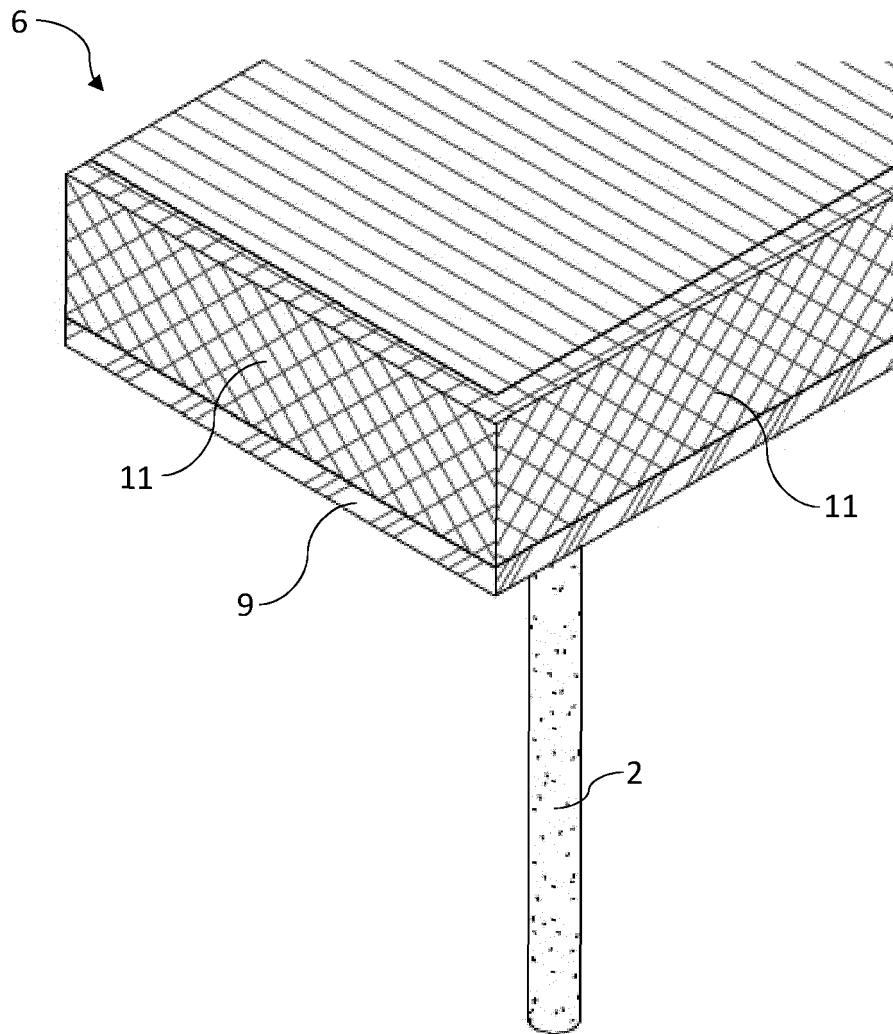


Fig. 4



**Fig. 5**



**Fig. 6**



## EUROPEAN SEARCH REPORT

Application Number

EP 22 21 5584

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category                                                                                                                                                                                                                | Citation of document with indication, where appropriate, of relevant passages                                                                            | Relevant to claim                                                                                                                                                                                            | CLASSIFICATION OF THE APPLICATION (IPC)                |
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|                                                                                                                                                                                                                         |                                                                                                                                                          |                                                                                                                                                                                                              | TECHNICAL FIELDS SEARCHED (IPC)                        |
|                                                                                                                                                                                                                         |                                                                                                                                                          |                                                                                                                                                                                                              | E04B<br>E02D                                           |
| The present search report has been drawn up for all claims                                                                                                                                                              |                                                                                                                                                          |                                                                                                                                                                                                              |                                                        |
| Place of search                                                                                                                                                                                                         |                                                                                                                                                          | Date of completion of the search                                                                                                                                                                             | Examiner                                               |
| The Hague                                                                                                                                                                                                               |                                                                                                                                                          | 6 June 2023                                                                                                                                                                                                  | López-García, G                                        |
| CATEGORY OF CITED DOCUMENTS                                                                                                                                                                                             |                                                                                                                                                          | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons |                                                        |
| X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                                          | & : member of the same patent family, corresponding document                                                                                                                                                 |                                                        |

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# **ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.**

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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