



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**09.01.2013 Bulletin 2013/02**

(51) Int Cl.:  
**E02D 27/02 (2006.01) E04B 1/00 (2006.01)**

(21) Application number: **11173100.6**

(22) Date of filing: **07.07.2011**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**

(72) Inventors:  
• **Hansen, Lars Erik**  
**2860 Søborg (DK)**  
• **Andreasen, Ole**  
**3520 Farum DK (DK)**

(71) Applicant: **Rockwool International A/S**  
**2640 Hedehusene (DK)**

(74) Representative: **Rohde, Vibeke Warberg et al**  
**Awapatent A/S**  
**Rigensgade 11**  
**1316 Copenhagen K (DK)**

(54) **A method for insulating the foundation of a building and an insulated foundation**

(57) The invention relates to a method for insulating the foundation of a building, where a load distribution layer is made on top of an insulating layer, both layers covering the intended floor area of the building substantially entirely. The formation of the insulating layer comprises the steps of: 1) laying a plurality of lamella elements made from mineral wool close to one another with the primary orientation of the mineral wool fibres being

approximately vertical, and 2) providing one or more cover element(s) on top of the lamella elements to cover an upper surface thereof substantially entirely. The cover elements may also be made from mineral wool and stone wool is preferred both for the cover elements and the lamella elements. The load distribution layer is preferably made from concrete cast in-situ and a capillary barrier may be provided underneath the insulating layer.

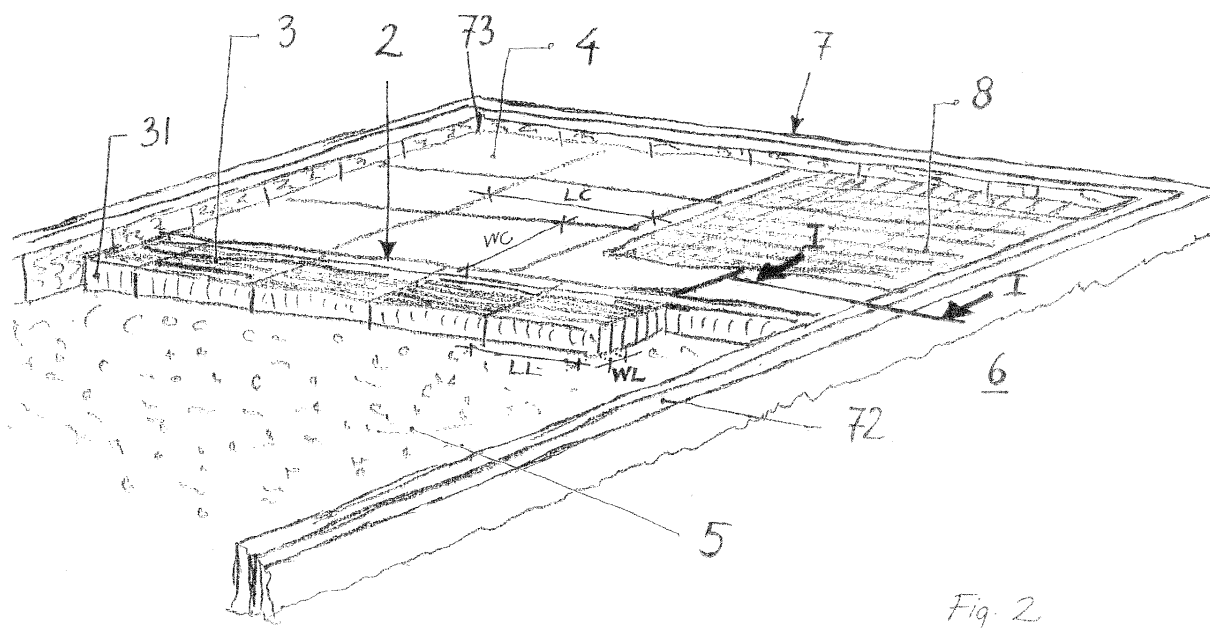


Fig. 2

## Description

**[0001]** The present invention relates to a method for insulating the foundation of a building, where a load distribution layer is made on top of an insulating layer, both layers covering the intended floor area of the building substantially entirely, and to an insulated foundation.

**[0002]** The load distribution layer, also known as the ground slab, is usually a concrete layer cast in-situ and spanning continuously from one side of the foundation to the other. The insulating layer is intended to prevent thermal loss from the floor. Depending on soil conditions, it is also common to provide a capillary barrier in the form of a layer of light expanded clay aggregate, pebbles or gravel underneath the insulating layer. Even though part of the load on the floor may be transferred to the plinth via the load distribution layer most of it has to be transferred to the ground via the insulating layer, which consequently must have a relatively good load-bearing capacity.

**[0003]** Mineral wool products in the form of high density batts has been used for this purpose, but their weight and the fact that three or more layers of batts have to be laid to achieved the desired insulation has led to this method being almost entirely abandoned. Other more light weight mineral wool products have had to be disregarded due to insufficient load-bearing capacities and walkability.

**[0004]** Instead boards of expanded polystyrene (EPS), which are both lightweight and relatively insensitive to moisture, are now used in most buildings. The light weight, however, involves other disadvantages, namely that the boards can be difficult to handle and keep in place under windy conditions and that they tend to float, which sometimes causes a displacement when concrete is poured over them for the formation of the loading distribution layer. Expanded polystyrene is also relatively difficult to cut and fit in corners and around drains. Moreover, expanded polystyrene shrinks for some time after it has been produced and if the boards are not stored sufficiently long before being used this has been known to result in gaps in the insulating layer and thus thermal bridges.

**[0005]** It is therefore the object of the invention to provide an insulating building foundation and a method for making such a foundation, which allows for the use of a more stable insulating material without resulting in substantially increased labour costs or negative impacts on the working environment.

**[0006]** This is achieved with a method where the formation of the insulating layer comprises the steps of laying a plurality of lamella elements made from mineral wool close to one another with the primary orientation of the mineral wool fibres of the lamella elements being approximately vertical, and providing one or more cover element(s) on top of the lamella elements to cover an upper surface of the lamella elements substantially entirely.

**[0007]** The object of the invention is further achieved with a foundation where the insulating layer comprises a plurality of lamella elements made from mineral wool lying closely adjacent to one another with the primary orientation of the mineral wool fibres of the lamella elements approximately vertical, and one or more cover elements on top of the lamella elements, covering them substantially entirely.

**[0008]** The vertical orientation of the fibres in the lamella elements means that the load-bearing capacity is relatively high in comparison to traditional mineral wool batts or mats, where fibres are oriented primarily in the plane of the batt or mat. This means that the weight of the insulation needed for insulating a certain area is lower than with traditional mineral wool products. The compressive strength of low density mineral wool insulation with fibers orientated substantially vertical to the major surface of the insulation is improved compared to fibers orientated horizontally, due to the fibers having a vertical orientation are better at carrying loads.

**[0009]** Despite the fact that the fiber orientation is vertical, the insulating properties are largely maintained, due to the low density of the mineral wool.

**[0010]** In addition, due to the high compressive strength in the direction of the fibres, the lamella elements undergo only very limited deformation.

**[0011]** This orientation of the fibres, however, also means that the upper surface of the lamella elements may not be well suited for receiving wet concrete or like materials used for the formation of the load distribution layer. Providing the cover element(s) on top provides for a substantially continuous top surface, which protects the upper surface of the lamella elements.

**[0012]** Equally importantly, the cover element(s) improves the walkability of the insulating layer, which is advantageous during construction, allowing the cover elements to serve as a bearing surface and be walked on, when the load distribution layer is made.

**[0013]** Another advantage of the cover elements is that they cover at least some of the joints between the lamella elements. This keeps the lamella elements from moving away from each other, both by providing friction on the upper surface of the lamella elements.

**[0014]** A still further advantage of the cover elements is that concrete is prevented from penetrating into the joints when making the load distribution layer. Such movement could result in gaps between the lamella elements and thus in the formation of thermal bridges.

**[0015]** In this, the term "thermal bridge" is intended to cover any structure resulting in an undesired thermal loss, i.e. both a heat loss when the ground is colder than the inside of the building and an undesired heating when the temperature of the ground is higher than the desired indoor temperature.

**[0016]** The strength of the fibres in the direction parallel to their length axis of course prerequisites that the fibres do not deflect. If the lamella elements are not laid very close to each other or the plinth, both along their sides

and ends, this may be a problem and the result will be that the lamella element becomes deformed. This will not only result in a loss of load-bearing capacity but will also influence the insulating properties. Laying the lamella elements in a bond pattern may lessen this problem as the joints are then no longer all on-line, and a deformation at one joint will therefore not result in increased loads on the neighbouring joints.

**[0017]** To further reduce the risk of thermal bridges and/or to increase the load distribution properties of the foundation as a whole, the cover elements can be laid so that at least some of the joints between them are not directly above parallel joints between lamella elements.

**[0018]** The cover element may in principle be made from any material suited for being in contact with the load distribution layer, which is typically, but not necessarily, made from concrete cast in-situ. Mineral wool being relatively inert fulfils this requirement and has the added advantage that the cover element will then contribute considerably to the insulating properties of the total structure. Alternatives could be precast lightweight concrete elements, boards of wooden materials such as plywood, plaster boards, steel or iron plates or the like.

**[0019]** In an advantageous embodiment, the lamella elements and/or the cover elements are made of mineral wool, which is both walkable and relatively insensitive to the variations in temperature and humidity occurring in foundations. Preferably, the mineral wool has a density of more than 55 kg/m<sup>3</sup> to ensure a good load-bearing capacity.

**[0020]** As the cover elements must carry the load distribution layer and transfer it to the lamella elements, it is advantageous to use a high density mineral wool board having a density of 130-230 kg/m<sup>3</sup> and a thickness of 20-40 mm.

**[0021]** Alternatively, the cover elements can be made with a relatively stiff upper part intended to face upwards in the mounted state and a softer lower part intended to face the lamella elements. When the cover elements are made of mineral wool, the combination of an upper part having a density of approximately 135-150 kg/m<sup>3</sup> and a thickness of approximately 10-20 mm and a lower part having a density of approximately 95 kg/m<sup>3</sup> and a thickness of approximately 30-40 mm and dimensions of approximately 1200 x 2000 mm has proven to function well. This results in a total weight of each cover element of less than 10 kg, which is acceptable under the working environment legislation of most countries.

**[0022]** Likewise, the size and weight of the lamella elements should be kept so that they can be handled by a single person. In practice, when using stone wool of a density of approximately 70 kg/m<sup>3</sup>, lamella elements being 200-300 mm wide, 200-500 mm high and 2000 mm long and thereby covering U-values between 0,15 and 0,08, have proven to be fitting, the height being the dimension which is substantially parallel to the primary direction of the fibres.

**[0023]** In most cases the lamella elements are simply

laid out closely side-by-side, the last one of a row possibly being cut to size or alternatively, but less preferred, compressed so that the floor area of the foundation is covered entirely. When the cover elements are then arranged on top, possibly with a similar size adaptation, the friction between the materials of the different elements is usually sufficient to provide a stable insulating layer. It is, however, also possible to secure the lamella elements and/or cover elements either to other parts of the foundation or to each other, which may be achieved by providing at least some of them with a surface coating in the form of an adhesive.

**[0024]** Likewise, the cover elements could be provided with a primer for preparing the surface for contact with concrete or the like.

**[0025]** Other surface coatings such as moisture repellents, fungicides etc. may be employed for increasing the durability of the insulating material of the lamella and/or the cover elements. Usually, the lamella elements are arranged directly on a capillary barrier layer as explained above to prevent a rise of soil moisture, thus keeping the insulation dry. In some cases, however, the insulating layer will be laid directly on the ground and in such cases a surface coating may be relevant, but it is of course also possible to provide for example a sheet of a plastic material underneath the insulating layer.

**[0026]** When making the load distribution layer from concrete cast in-situ, some or all of the cover elements may be provided with spacers for concrete reinforcement, which may for example be in the form of a mesh of steel wires. Said spacers can be either integrated in the cover elements or applied to them in-situ, either before or after installation. When concrete is then cast on top of the cover elements, the spacers and reinforcement will become embedded.

**[0027]** The method and foundation described herein is based on the use of a single layer of lamella elements (independent of the required thickness of insulation), since this will be sufficient to achieve a good insulation, which fulfils the building regulations of most countries. It is, however, to be understood that it is also possible to lay out two or more layers of lamella elements on top of each other. In that case the lamella elements in each layer should preferably be laid out with their length axis direction being perpendicular to the direction of the length axes of the lamella elements in the layer below.

**[0028]** In the following the invention will be described in more detail with reference to the drawing, where:

Fig. 1 is a cross sectional view of a first embodiment of a foundation according to the invention, and Fig. 2 is a perspective sketch of the foundation in Fig. 1 during construction, the line I-I indicating the cross-section in Fig. 1.

**[0029]** A foundation according to the invention including a load distribution layer 1 and an insulating layer 2 composed of lamella elements 3 with cover elements 4

on top is shown in Fig. 1. The lamella elements are laid out directly onto a capillary barrier 5 isolating them from the ground 6. A plinth 7 intended for supporting a load bearing structure (not shown) of for example a building defines the outer boundaries of the foundation. In this embodiment the plinth 7 is composed of a foundation block 71 made from concrete and two layers 72 of insulated foundation blocks made from aircrete with a filling of a foamed plastic serving as insulation.

**[0030]** The foundation may include further features such as capillary barriers on the outer side of the plinth 7, but as such features will be readily imaginable to the skilled person and are not of consequence for the present invention, they will not be described here. Likewise, it is to be understood that the dimensions and construction of the features shown may vary depending for example of the loads to be carried by the foundation, the climate zone, soil conditions, local building traditions etc. without departing from the scope of the invention.

**[0031]** In the embodiment shown in Fig. 1, the load distribution layer 1 is made from concrete cast in-situ and is thus without joints, except for where it meets the plinth 7. This way of making the load distribution layer is well tested and works well under virtually all conditions, but alternatives such as precast concrete slabs, boards of wooden materials or composites may also be used. Materials having large coefficient of thermal expansion or which display large volume changes in response to changes in humidity should, however, be used with care.

**[0032]** The lamella elements 3 and cover elements 4 are here made from stone wool. In the lamella elements the primary orientation of the fibres are vertical, while the cover elements are walkable stone wool boards with a relative high density at least at the upper side facing the load distribution layer. Details with regards to these materials will be described later.

**[0033]** Referring now also to Fig. 2, where the foundation is shown in a perspective view with only some of the lamella elements and cover elements laid, each cover element 4 has a width WC, which is considerable larger the width WL of a lamella element 3, here approximately seven times larger, and a length CL which is somewhat larger than the length LL of a lamella element, here 1½ times larger. The height of the cover elements HC is considerable smaller than the height of lamella elements HL, here constituting approximately 1/3 as may be seen in Fig. 1. These dimensions are intended only to illustrate one possible embodiment and it is to be understood that they may vary greatly depending for example on the material used for the cover element and considerations relating to manufacture, transportation and handling. Often the height of the cover elements will constitute only 1/10 of the height of the lamella elements or even less.

**[0034]** When the lamella elements 3 and cover elements 4 are laid in a simple side-by-side and end-to-end pattern as here, this means that joints between the cover elements are present only over every seventh joint between lamella elements at the length sides and every

third joint between end sides of the lamella elements. Other size-ratios between the lamella elements 3 and cover elements 4 will result in different patterns, where coinciding joints are more or less frequent. Alternatively, the cover elements may be given a different shape or arranged in a different orientation so that the joints between them are not parallel to the joints between lamella elements, but this require a more complex production and/or laying technique and will therefore rarely be expedient.

**[0035]** Laying the lamella elements side-by-side and end-to-end as shown in Fig. 2 is relatively easy. The workmen can simply start from the corner 73, where the two sides of the plinth 7 meet and then lay the lamella elements close against each other until the entire area is covered. Some lamella elements and/or cover elements may, however, have to be cut to size to fit the area of the foundation as illustrated by the lamella elements in the row to the left in Fig. 2, which are only half as long as the others. It is of course possible to lay all lamella elements and to then cover them with cover elements, but it will usually be preferred to insulate an area of approximately 10 m<sup>2</sup> with both lamella elements and cover elements and then continue with another section of similar size until the entire area of the foundation has been insulated.

**[0036]** When using lamella and cover elements made from stone wool, the materials used for insulating area of approximately 10 m<sup>2</sup> corresponds to what can be loaded onto a standard pallet.

**[0037]** Under normal conditions a side-by-side and end-to-end layout shown in the drawing will result in an insulating layer 2 having satisfactory properties. However, if wanting to reduce the risk of the formation of thermal bridges, it will be advantageous to lay the lamella elements in a bond pattern resembling the pattern of the bricks in masonry, where the coinciding joints will be fewer or at least distributed more evenly. This reduces the risk of fresh concrete penetrating into the joint, where it may force the cover elements and/or lamella elements apart.

**[0038]** As mentioned above the lamella elements 3 are made from stone wool, where the primary orientation of the fibres is vertical. This means that loads from the load distribution layer 1 affect the material substantially in parallel to the length axis of the fibres, where the strength is high, and that the stone wool with a relatively low density can thus be used. This reduces the loads to be carried by the workmen laying the lamella elements and has a positive impact on the insulating properties. In addition, the stone wool is characterized by a low deformation in compression in this direction, a factor which might otherwise potentially reduce the insulating properties.

**[0039]** Regarding the cover elements 4, it is presently preferred that these are made from stone wool, but other materials may be employed as long as they are suited for contact with both the lamella elements and the load distribution layer, or at least provided with a surface layer that is.

**[0040]** In a preferred embodiment the cover elements are stone wool boards, where the orientation of the fibres is substantially in the plane of the layer of cover elements. This allows them to contribute to the load distribution and decrease the risk of cement sludge penetrating into the material. The cover elements are preferably of a somewhat higher density than the low density lamella elements and typically also board shape as opposed to the preferred rod-shape of the lamella elements. A density of the cover element of 130-230 kg/m<sup>3</sup> as opposed to 90-220 kg/m<sup>3</sup> for the lamella elements is preferred.

**[0041]** Alternatively, to further increase the load distribution properties, the cover elements may be boards with an upper part having a density, which is higher than the density of a lower part arranged against the lamella elements. The exact densities of these two parts may vary, but it is preferred that the upper part has a density of 90-180 kg/m<sup>3</sup>, preferably 110-160 kg/m<sup>3</sup>, more preferred approximately 135 kg/m<sup>3</sup>, and that said lower part has a density of 65-125 kg/m<sup>3</sup>, preferably 80-110 kg/m<sup>3</sup>, more preferred approximately 95 kg/m<sup>3</sup>. The dimensions of the upper and lower parts may also vary depending on demands, but it is preferred that the upper part has a thickness of 3-50 mm, preferably 5-30 mm, more preferred approximately 10-20 mm, and that the lower part has a thickness of 10-60 mm, preferably 20-50 mm, more preferred approximately 30-40 mm.

**[0042]** There need not be a sharp line between the upper and the lower part, meaning that the density may change gradually, and it is even possible to make boards, where the weight of the load distribution layer compresses the upper part to the desired density. Likewise it is to be understood that one or more further parts may be provided and that cover elements made of other materials than stone wool may also have two or more parts.

**[0043]** As may be seen in Fig. 2, a steel wire mesh 8 is laid out on top of the cover elements 4. This mesh is intended to serve as reinforcement in a concrete layer, which is to be cast on top of the cover elements to serve as the load distribution layer. Preferably the reinforcement mesh is provided with spacers (not visible) on its underside to keep it at a distance above the cover elements so that the mesh will become completely embedded in the concrete. Spacers are preferably made from a material having a low thermal conductivity, such as plastic or concrete and may be integrated in the cover elements. They may be simple feet inserted between the mesh and the cover elements, resting on top of these, or they may be made to penetrate into the material of the cover elements, which will contribute to keeping them in place when the fresh concrete is poured over them.

**[0044]** Different features of the embodiments described above may be combined in other ways than those explicitly described and/or replaced with alternatives without departing from the scope of the claims. As an example, two layers of cover elements may be provided on top of each without coinciding joints to prevent concrete from penetrating the insulating layer. Another example

is the use of plastic sheets or the like at different levels in the foundation serving as moisture barriers, vapour barriers, concrete shuttering, load distributor or the like.

## Claims

1. A method for insulating the foundation of a building, where a load distribution layer is made on top of an insulating layer, both layers covering the intended floor area of the building substantially entirely, **characterized in that** the formation of the insulating layer comprises the steps of:

laying a plurality of lamella elements made from mineral wool close to one another with the primary orientation of the mineral wool fibres of the lamella elements being approximately vertical, and

providing one or more cover element(s) on top of the lamella elements to cover an upper surface of the lamella elements substantially entirely.

2. A method according to claim 1, where the lamella elements are laid in a bond pattern and/or where the cover elements are laid so that at least some of the joints between them are not directly above parallel joints between lamella elements.

3. A method according to claim 1 or 2, where the lamella elements and/or the cover elements are made of mineral wool, preferably having a density of more than 55 kg/m<sup>3</sup>.

4. A method according to claim 3, where the cover elements are made from mineral wool having a density of 120-180 kg/m<sup>3</sup>.

5. A method according to claim 3, where the cover elements are made from mineral wool and arranged with an upper part facing upwards and a lower part facing the lamella elements, said upper part having a density of 90-220 kg/m<sup>3</sup>, preferably 120-180 kg/m<sup>3</sup>, more preferred approximately 135-150 kg/m<sup>3</sup>, and a thickness of 3-50 mm, preferably 5-30 mm, more preferred approximately 10-20 mm, and said lower part having a density of 65-125 kg/m<sup>3</sup>, preferably 80-110 kg/m<sup>3</sup>, more preferred approximately 95 kg/m<sup>3</sup>, and a thickness of 10-60 mm, preferably 20-50 mm, more preferred approximately 30-40 mm.

6. A method according to any one of the preceding claims, where the width of the lamella elements are 50-500 mm, preferably 100-400 mm, more preferred approximately 200-300 mm, the height of the lamella elements are 200-500 mm, and the length of the lamella elements are 1500-2500 mm, preferably pre-

ferred approximately 2000 mm, the height being the dimension, which is substantially parallel to the primary orientation of the mineral wool fibres and substantially vertical in the laid out state.

7. A method according to any one of the preceding claims, where at least some of the lamella elements and/or cover elements are provided with a surface coating, such as an adhesive, a moisture repellent, a fungicide or a primer.

8. A method according to any one of the preceding claims, where at least some of the cover elements are provided with spacers for concrete reinforcement.

9. A foundation for a building comprising a load distribution layer on top of an insulating layer, both layers covering the floor area of the building substantially entirely, **characterized in that** the insulating layer comprises a plurality of lamella elements made from mineral wool lying closely adjacent to one another with the primary orientation of the mineral wool fibres of the lamella elements approximately vertical, and one or more cover elements on top of the lamella elements, covering them substantially entirely.

10. A foundation according to claim 9, where the lamella elements lay in a bond pattern and/or where at least some of the joints between the cover elements are not directly above parallel joints between lamella elements.

11. A foundation according to claim 9 or 10, where the lamella elements and/or the cover elements are made of mineral wool, preferably having a density of more than 55 kg/m<sup>3</sup>.

12. A foundation according to claim 11, where the cover elements are made from mineral wool having a density of 120-180 kg/m<sup>3</sup>.

13. A foundation according to claim 11, where the cover elements are made from mineral wool and each has an upper part facing upwards and a lower part facing the lamella elements, said upper part having a density of 90-220 kg/m<sup>3</sup>, preferably 120-180 kg/m<sup>3</sup>, more preferred approximately 135-150 kg/m<sup>3</sup>, and a thickness of 3-50 mm, preferably 5-30 mm, more preferred approximately 10-20 mm, and said lower part having a density of 65-125 kg/m<sup>3</sup>, preferably 80-110 kg/m<sup>3</sup>, more preferred approximately 95 kg/m<sup>3</sup>, and a thickness of 10-60 mm, preferably 20-50 mm, more preferred approximately 30-40 mm.

14. A foundation according to any one of claims 9-13, where the width of the lamella elements are 50-500 mm, preferably 100-400 mm, more preferred ap-

proximately 200-300 mm, the height of the lamella elements are 200-500 mm and the length of the lamella elements are 1500-2500 mm, preferably 2000 mm, the height being the dimension, which is substantially parallel to the primary orientation of the mineral wool fibres and substantially vertical in the laid out state.

15. A foundation according to any one of claims 9-14, where at least some of the lamella elements and/or cover elements have a surface coating, such as an adhesive, a moisture repellent, a fungicide or a primer.

16. A foundation according to any one of claims 9-15, where the load distribution layer is made from concrete cast in-situ and/or where it further comprises a capillary barrier underneath the insulating layer.

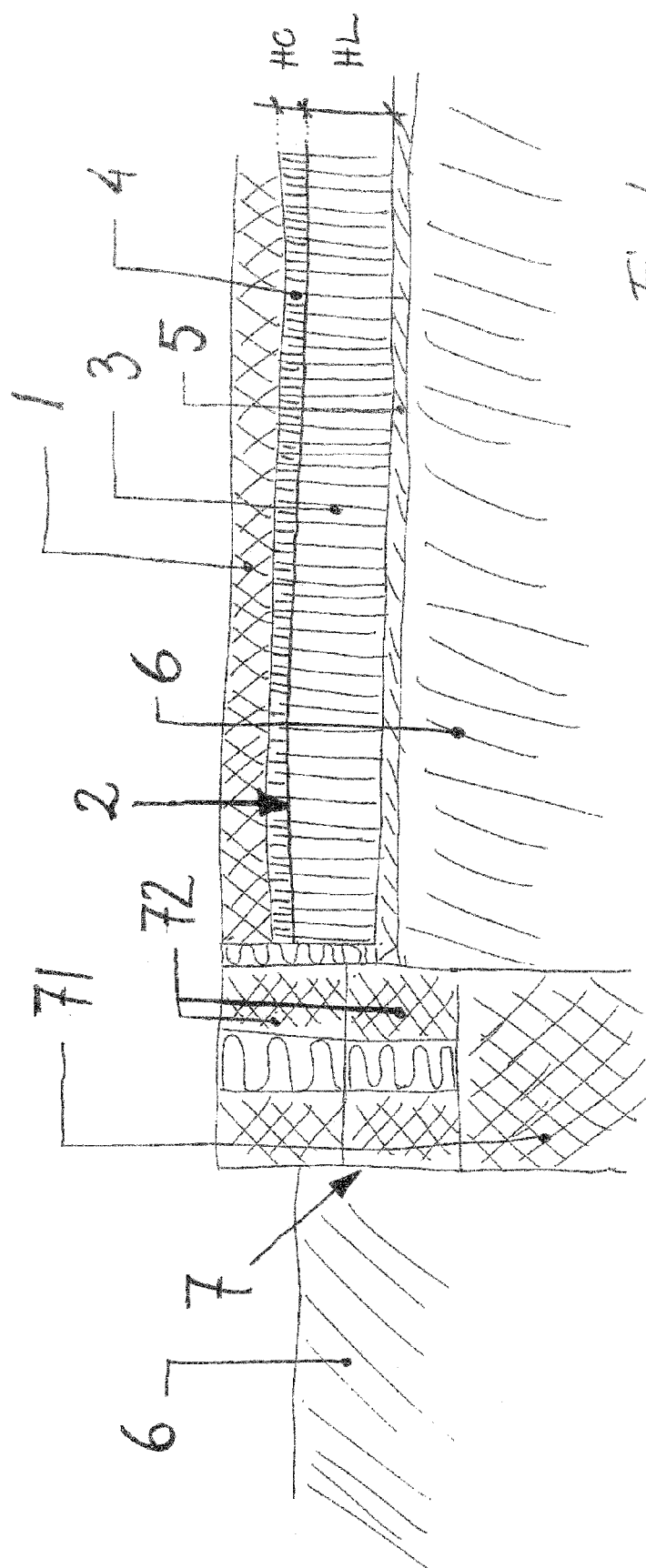


Fig 1

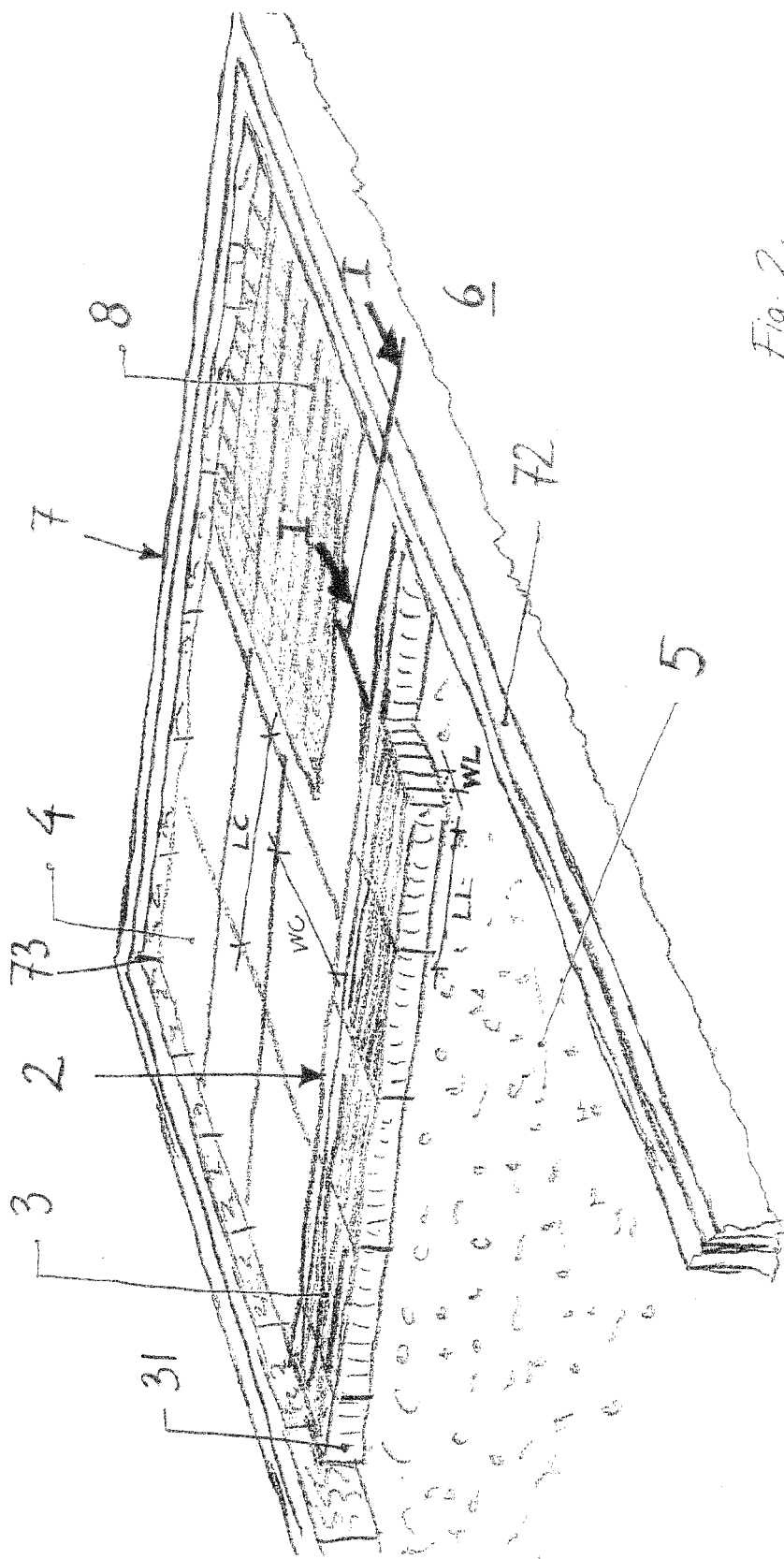


Fig. 2



## EUROPEAN SEARCH REPORT

Application Number  
EP 11 17 3100

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                               |                                                     |                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Citation of document with indication, where appropriate, of relevant passages                                                                                                                 | Relevant to claim                                   | CLASSIFICATION OF THE APPLICATION (IPC) |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EP 1 666 672 A2 (SKANSKA SVERIGE AB [SE])<br>7 June 2006 (2006-06-07)<br>* paragraph [0039]; figures 4,7 *                                                                                    | 1,9                                                 | INV.<br>E02D27/02<br>E04B1/00           |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | WO 2008/155401 A1 (ROCKWOOL INT [DK];<br>JACOBSEN BENT [DK])<br>24 December 2008 (2008-12-24)<br>* page 1, line 23 - page 2, line 2;<br>figures 1-3 *<br>* page 8, lines 9-12 *<br>* page 9 * | 1-16                                                |                                         |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | WO 02/35025 A1 (FLETCHER BUILDING HOLDINGS<br>LTD [NZ]; HANCY LEONARD JAMES [NZ];<br>BENNETT) 2 May 2002 (2002-05-02)<br>* page 3, lines 15-16,28-29; figure 1 *                              | 1-16                                                |                                         |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | FR 2 586 051 A1 (GRYGA JEAN [FR])<br>13 February 1987 (1987-02-13)<br>* pages 7-8; figures 2,3 *                                                                                              | 1,9                                                 |                                         |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EP 0 130 957 A2 (PROFOMENT UTVECKLINGS AB<br>[SE]) 9 January 1985 (1985-01-09)<br>* page 5 - page 6; figure 2 *                                                                               | 1-16                                                | TECHNICAL FIELDS<br>SEARCHED (IPC)      |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | DE 32 23 246 A1 (OESTERR HERAKLITH AG<br>[AT]) 13 January 1983 (1983-01-13)<br>* abstract *<br>* page 12, line 4 - page 13, line 21;<br>figure 1 *                                            | 1-16                                                | D04H<br>E04B<br>E02D                    |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | DE 297 14 251 U1 (THUERINGER<br>DAEMMSTOFFWERKE GMB [DE])<br>4 December 1997 (1997-12-04)<br>* the whole document *                                                                           | 1-16                                                |                                         |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                               |                                                     |                                         |
| Place of search<br>The Hague                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                               | Date of completion of the search<br>31 January 2012 | Examiner<br>Leroux, Corentine           |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                                                                                                                                               |                                                     |                                         |

1  
EPO FORM 1503 03.82 (P04C01)

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

EP 11 17 3100

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  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

31-01-2012

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| EP 1666672 A2                             | 07-06-2006          | EP 1666672 A2              | 07-06-2006          |
|                                           |                     | SE 527708 C2               | 16-05-2006          |
|                                           |                     | SE 0402398 A               | 07-04-2006          |
| -----                                     | -----               | -----                      | -----               |
| WO 2008155401 A1                          | 24-12-2008          | NONE                       |                     |
| -----                                     | -----               | -----                      | -----               |
| WO 0235025 A1                             | 02-05-2002          | AU 1112402 A               | 06-05-2002          |
|                                           |                     | CA 2425989 A1              | 02-05-2002          |
|                                           |                     | US 2004096645 A1           | 20-05-2004          |
|                                           |                     | WO 0235025 A1              | 02-05-2002          |
| -----                                     | -----               | -----                      | -----               |
| FR 2586051 A1                             | 13-02-1987          | NONE                       |                     |
| -----                                     | -----               | -----                      | -----               |
| EP 0130957 A2                             | 09-01-1985          | AU 2994484 A               | 16-05-1985          |
|                                           |                     | BR 8403190 A               | 11-06-1985          |
|                                           |                     | CA 1214947 A1              | 09-12-1986          |
|                                           |                     | DE 3466264 D1              | 22-10-1987          |
|                                           |                     | DK 309784 A                | 31-12-1984          |
|                                           |                     | EP 0130957 A2              | 09-01-1985          |
|                                           |                     | ES 8505757 A1              | 01-10-1985          |
|                                           |                     | FI 842632 A                | 31-12-1984          |
|                                           |                     | JP 60086343 A              | 15-05-1985          |
|                                           |                     | NO 842600 A                | 02-01-1985          |
|                                           |                     | US 4578912 A               | 01-04-1986          |
| -----                                     | -----               | -----                      | -----               |
| DE 3223246 A1                             | 13-01-1983          | AT 370470 B                | 11-04-1983          |
|                                           |                     | DE 3223246 A1              | 13-01-1983          |
| -----                                     | -----               | -----                      | -----               |
| DE 29714251 U1                            | 04-12-1997          | NONE                       |                     |
| -----                                     | -----               | -----                      | -----               |