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(54) **A PILE GROUNDED CONSTRUCTION AND A METHOD FOR MAKING SUCH A CONSTRUCTION**

KONSTRUKTION MIT PFAHLFUNDAMENT UND VERFAHREN ZUR HERSTELLUNG EINER DERARTIGEN KONSTRUKTION

CONSTRUCTION À FONDATION PAR PIEUX ET MÉTHODE DE PRODUCTION D’UNE TELLE CONSTRUCTION

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Description

[0001] The present invention relates to a method for constructing a pile grounded building structure including the steps of arranging a plurality of piles in the ground, and constructing the building structure in a manner so that a fixed connection is achieved between it and at least some of the piles. The invention further relates to a construction comprising a pile grounded building structure, where at least some of the piles are fixed in the building structure.

[0002] Pile grounding, also known as a pile foundation, is used where the soil bearing capacity does not allow the use of simpler types of foundations or where an uplift on the construction is not equalized by its self-weight, the latter often being the case in wholly or partially submerged constructions (see for example US2010/275526A1).

[0003] In constructions, which are of limited size and/or massive, such as for example a bridge pier, expansion of the soil underneath it can often be taken up by the neighbouring soil, possibly resulting in a soil uplift around the construction. Likewise, if the pile density is high, there will be little soil that can expand. If, on the other hand, the construction is hollow, involves fewer piles and/or covers a larger area, soil expansion have been known to course fractures in building structures, particularly in ground decks made from concrete and where horizontal expansion of the soil is hindered by a strip foundation.

[0004] It is therefore the object of the invention to provide a method for constructing a pile grounded building structure resulting in a construction, which is better capable of withstanding soil expansion.

[0005] This object is achieved with a method including the following steps to be performed before constructing the building structure:

c) calculating the expected area weight of the building structure and the resulting compressive force σ_D affecting material underneath of the building structure during construction thereof,
d) calculating the breaking strength σ_B of the building structure,
e) calculating the expected maximum soil uplift ε_G of the ground,
f) providing compensation elements having:

- a compressive strength ε_C, which is larger than the compressive force σ_D of the building structure and smaller than the breaking strength σ_B of the building structure, and
- a maximum strain ε_C, which is bigger than the expected maximum soil uplift ε_G of the ground,

g) arranging the compensation elements on the ground , so that they cover the area to be covered by the building structure substantially entirely.

[0006] When such compensation elements are used as an intermediary layer between the building structure and the ground, any forces affecting the construction from below due to soil expansion will result in the compensation elements collapsing before the breaking strength of the building structure is reached. Due to the relatively large strain in the compensation elements, a direct transmission of forces from the ground to the building structure is prevented.

[0007] When making the building structure from concrete by in situ casting, the concrete may be poured directly onto the compensation elements, thus minimizing the need for formwork. Depending on the design of the compensation elements it is, however, also possible to arrange one or more cover element(s) on top of the compensation elements to protect them from direct contact with the concrete. Such cover elements may also contribute to the distribution of loads on the compensation elements.

[0008] It is to be understood that for the compensation elements to be used as a support for the building structure during construction thereof, the distance between the ground and the intended lowermost surface of the building structure must be compensated for. This means that the compensation elements together with any additional elements used in the space between the ground and the building structure must have a total height corresponding substantially to this distance.

[0009] With respect to step f) it is noted that the compressive strength σ_C of the compensation elements is to be understood as the yield strength, i.e. the maximum strength up to which deformation is still elastic. Once the building structure is finished, however, the need for the support of the compensation elements is considerably reduced or may no longer be needed at all and irreversible strain in the compensation element is thus often acceptable.

[0010] It is also noted that the compensation elements should also be capable of carrying the load of any traffic necessary for the construction of the building structure and that such loads is advantageously included in the calculation of the compressive force σ_D. Likewise, the compensation elements should preferably be capable of withstanding local loads, which may for example occur if a person steps on a compensation element.

[0011] With respect to step d), the calculation of the breaking strength σ_B of the building deck structure should be based on the point in the construction, which will break first under the influence of a force from below caused by a soil uplift. The location of this weakest point will depend on a number of factors, not least relating to the use of reinforcement, and thus has to be determined for each individual construction. It is also noted that the break may result from shearing forces, tensile forces, compressive forces or a combination of these depending on the structure in question and that all possible breakage patterns should take into consideration when making the calculations. Finally it is noted that if the construction includes several building structures, the calculation must include all of them.

[0012] Throughout this text reference is made to concrete, which is by far the most commonly used material for pile grounded building structures, but it is to be understood that the invention also applies to building structures made from other materials.

[0013] The compensation elements may in principle be made from any suitable material and with any geometry, which is capable of carrying the loads of the building structure during its construction and any traffic associated with its construction, and of compensating for subsequent soil uplift.

[0014] At present it is preferred to use lamella elements made from mineral wool, preferably having a density of 30-75 kg/m^3, for stone wool 50-75 kg/m^3, as compensation elements, these lamella elements being laid close to one another with the primary orientation of the mineral wool fibres of the lamella elements being approximately vertical. The vertical orientation of the fibres means that each of them function as a small pillar, resulting in the load-bearing capacity being relatively high in comparison to traditional mineral wool batts or mats of the same density. When a load is applied to such a lamella element in a direction substantially in parallel to the orientation of the fibres, the element initially displays only very limited deformation, but when exceeding the maximum bearing capacity of the fibres, they buckle causing the element to yield with a considerable deformation.

[0015] The vertical orientation of the fibres, however, also means that the upper and lower surfaces of the lamella elements are of a relatively open structure, which may allow cement paste to penetrate between the fibres, when concrete is cast directly onto the compensation elements as described above. When the cement cures this may influence the bearing capacity of the lamella elements and hence potentially result in them not being able to serve their purpose as compensation elements. This may be avoided by providing the lamella elements with a surface layer or by applying cover elements on top of the lamella elements as described above. Advantageously, the cover elements are laid so that joints between them are not directly above parallel joints between compensation elements. Cover elements as well as compensation elements may be laid in a bond pattern to provide for a more homogeneous layer.

[0016] Other types of compensation elements are made from materials of a more homogeneous structure, such as expanded polystyrene or like foamed materials, and provided with weakening zones allowing them to collapse wholly or partially. Simple examples of such weakening zones are hollows in the material or sectors of a material of a lower density. In a more complex embodiment spheres filled with a solvent is embedded in the material and designed to burst and release the solvent when exposed to a pre-defined pressure, thereby dissolving the material of the compensation element and reducing its strength. The solvent can be any suitable material depending on the material used for the compensation element, including organic solvents, but possible impacts of the environment and worker health should of course be taken into consideration.

[0017] Yet another type of compensation element comprises an outer shell and an inner lumen filled with a fluid, said outer shell allowing at least some of the fluid to escape when the compensation element is exposed to a pressure larger than the compressive force σ_D resulting from the weight of the building structure. The fluid is preferably water or air, which are readily available and non-toxic, and the outer shell could be a textile material, allowing the fluid to escape through the weave under pressure. An even simpler embodiment, however, uses an outer shell where joints are made so sufficiently weak that they will burst when a pre-defined pressure is reached inside the compensation element.

[0018] For use when casting the building structure in situ, spacers for holding reinforcement may be arranged on at least some of the compensation elements or cover elements if any. These spacers may be an integral part of the compensation elements or cover elements or may be arranged subsequent to step g) of the method.

[0019] Moreover, the compensation elements and/or cover elements may be provided with a surface coating or additive, such as an adhesive, a moisture repellent, a fungicide or a primer, depending on demands.

[0020] In the following the invention will be described in closer detail with reference to examples shown in the schematic drawing where:

Fig. 1 is a cross-sectional view of a pile grounded construction including a strip foundation and a ground deck in an initial state,

Fig. 2 is a view of the detail marked II in Fig. 1 during a period of soil uplift,

Fig. 3 is a view corresponding to that in Fig. 2 at a later stage where the soil has reverted to its initial state,

Fig. 4 is a view corresponding to that in Fig. 2, but in the initial state and showing a second embodiment of the compensation element,

Fig. 5 is a view corresponding to that in Fig. 4, but showing a third embodiment of the compensation element, and

Fig. 6 is a view corresponding to that in Figs. 4 and 5, but showing a fourth embodiment of the compensation element.

[0021] The construction in Fig. 1 comprises foundation piles 10,11,12,13,14 and two building structures in the form of a strip foundation 2 and a ground deck 3 arranged above a stripped ground surface 4'. The space between the ground deck 3 and the stripped ground surface 4' and delimited by the strip foundation 2 is filled with one or more compensation elements 5, the function of which will be described below.

[0022] The piles 10,11,12,13,14, which may be rammed into the ground 4, cast in situ in drilled holes or provided in any other expedient manner, are in direct contact with the strip foundation 2 and the ground deck 3, respectively, and are fixed therein as it is common practice. This fixed connection may be achieved by embedding an upper end of a pile 12 projecting over the stripped ground surface 4' in the concrete, which are cast in situ, or by letting the concrete penetrate into passages between the compensation elements 5 to reach a pile 11,13 ending at a lower level. It is, however also possible to use pre-made elements for the strip foundation and ground deck and to interconnect them to the piles. Methods for making these interconnections, both when using in situ cast building structures and pre-made elements, are known to the skilled person and will therefore not be described in detail here.

[0023] Though not visible in Fig. 1, it is to be understood that piles 10,11,12,13,14 are distributed along the length of the strip foundation 2 and the ground deck 3, i.e. the direction into the plane of the drawing in Fig. 1. The distribution of the piles is not necessarily even as the need for piles is dictated by local soil conditions and it is even possible to have a construction, where one part of the construction is pile grounded, whereas the ground underneath other parts has sufficient bearing capacity to make piles superfluous. Likewise, the length of the piles depends on local soil condition and the expected loads on the building structure and will therefore normally vary over the construction as also illustrated in Fig. 1.

[0024] In the constructions shown in Fig. 1 the level 4' of the stripped ground surface on the inner side of the construction is lower than the level 4" of the ground surface on the outer side, which may be achieved either by excavating a construction pit or by arranging fill material on the outer side. It is, however, to be understood that the stripped ground surface level 4' on the inner side may be the same as or higher than that 4" on the outer side. It is noted that the wording "stripped ground surface" is used to indicate that the ground surface has been prepared for the construction work, normally including the removal of top soil, and that this surface is therefore not necessarily at level with the original ground surface. It is, however, to be understood that in some cases the preparation may involve the addition of fill material to achieve an elevated ground surface and that the stripped ground surface is then higher than the original ground surface.

[0025] Depending on the over-all construction, the strip foundation 2 and ground deck 3 may be regarded as two separate building structures or as one coherent building structure and it is to be understood that the construction may include further building structures.

[0026] In the drawing, the compensation members 5 are drawn with a signature normally used for insulating materials, since mineral wool is presently the preferred material, but other materials may also be used as will be explained later. In this context the insulating properties of the compensation elements are in principle of no consequence, but may be considered an added benefit.

[0027] Moreover, in Fig. 1 the compensation elements 5 are drawn as a single homogeneous unit filling the spaces between piles 1 underneath the ground deck 3 entirely, but this need not be the case. Depending on the material used, the compensation element will, however, often be smaller and hence several elements will be needed for filling the space. In that case, it may be advantageous to lay the compensation elements in a bond pattern and/or to provide cover elements (not shown) covering the joints between the compensation members. This will not only provide a better and more continuous load bearing capacity but will also reduce the risk of fresh concrete penetrating into the joints. Likewise, it is possible to arrange two or more compensation members on top of each other so that they together form a stratified compensation layer (not shown).

[0028] Regardless of the material used and their dimensions, the compensation elements 5 must fulfil three requirements: Firstly, they must have a compressive strength σ_C, which is larger than the compressive force σ_D resulting from the area weight of the ground deck 3, secondly, the compressive strength σ_C must be smaller than the breaking strength σ_B of the ground deck 3, and, thirdly, it must have a maximum strain ε_C, which is bigger than the expected maximum soil uplift ε_G of the ground 4.

[0029] The first requirement allows the compensation element 5 to serve as a support for the ground deck 3 during its construction, typically serving as a receiving surface for in-situ concrete and supporting the weight of the concrete and associated reinforcement until the concrete has cured. The compensation elements should preferably also be able to carry the weight of persons standing and walking on them and any other loads, which could reasonably be expected during the construction of the deck.

[0030] The second and third requirement in combination means that if anything breaks as a consequence of soil uplift it is the compensation member 5, which will simply collapse and hence protect the ground deck 3 from damage. This is illustrated in Fig. 2, where the initial level of the stripped ground surface is indicated by 4' and a subsequent level during a period of soil uplift by 4"'. When the stripped ground surface rises, the compensation member 5 is simply compressed from its initial height h_1 to a reduced height h_2, the change in height Δh corresponding to the magnitude of the soil uplift. Of course, if the compensation member is compressed to its maximum deformation and the stripped ground surface level continues to rise, it will eventually result in a higher pressure affecting the ground deck from below. It should therefore be ensured that the compensation elements are sufficiently high to be able to compensate for any soil uplift, which may reasonably be expected during the life time of the construction in question.

[0031] In Fig. 3 the cause for the soil uplift is no longer present and the stripped ground surface has returned to its original level 4', but the compensation member 5 has been permanently deformed, as indicated by the modified signature, and therefore has not followed this movement, resulting in the formation of a space 6 between the ground deck 3 and the stripped ground surface. Such a permanent deformation is usually acceptable as the ground deck will normally be self-supporting once the concrete has cured.

[0032] In Fig. 3 the space is illustrated between the deformed compensation member 5 and the stripped ground surface 4'. This will typically be the result when concrete has been cast directly onto the upper surface of the compensation member, which consequently sticks to the concrete. In other cases, however, the compensation member may follow the stripped ground surface so that the space is formed between the compensation member 5 and the ground deck 3, or different layers of compensation members and/or associated elements may come apart and form one of more spaces between them.

[0033] Experiments have shown that so-called lamella elements of rock wool are well suited for use as compensation elements 5. These elements have a relatively homogeneous fibre orientation and when arranged with the majority of the fibres extending substantially in the direction of the forces applied, they have a high load bearing capacity compared to other mineral wool products of similar density and display a relatively low elastic deformation. In the context of the present invention this means that lamella elements arranged with a substantially vertical orientation of the fibres carry the loads of the building structure well.

[0034] When exceeding the yield strength of the lamella elements, however, the deformation is considerable as the fibres buckle successively and hence the lamella elements are able to compensate for considerable soil uplifts.

[0035] Lamella elements made from mineral wool with a density of 30-75 kg/m^3, for stone wool 50-75 kg/m^3, and a height of 50-500 mm, preferably 100-300 mm, will be well suited for most constructions. In case of extreme uplifts or extremely heavy building structures, the height or density, respectively, may, however, need to be even bigger.

[0036] Manual handling at the construction site will be possible if the width of such lamella elements is 50-600 mm, preferably approximately 200-300 mm and the length is 1500-2500 mm, preferably approximately 2000 mm.

[0037] Due to the orientation of the fibres, not all lamella elements are suited for receiving concrete directly onto the upwards facing surface unless provided with some sort of surface covering and it may therefore be expedient to cover them with one or more cover elements as also explained above. This may simply be a sheet of plastic, plywood plates or the like, but could also be mineral wool bats, preferably having a density of 120-220 kg/m^3. Such cover elements may also contribute to the distribution of loads and may function as a slip layer preventing the compensation elements 5 from sticking to the ground deck 3 as shown in Fig. 3.

[0038] Many other materials apart from mineral wool will also be usable for the compensation members, as the balance between bearing capacity and the ability to yield may be achieved in many ways.

[0039] One example of such an alternative embodiment is shown in Fig. 4, where a compensation elements made from a foam material, such as expanded polystyrene, is provided with openings 51 serving as weakening zones. When a pre-determined load smaller than the breaking strength of the building structure is applied, the walls 52 between the openings collapse wholly or partially into the openings causing a reduction of the height of the compensation member. Here the openings are shown as closed spaces, but they may also expend to a surface of the compensation member as indicated by the dotted lines.

[0040] The embodiment in Fig. 4 is, however, presently less preferred as it involves a more abrupt reduction of the height of the compensation member than when using lamella elements of mineral wool and the material itself has less potential for compression.

[0041] Another alternative is shown in Fig. 5, where spheres 53 filled with a solvent is embedded in the material and designed to burst and release the solvent when exposed to a pre-defined pressure. The zone containing the spheres thus effectively becomes a weakening zone and it is possible to include spheres of different strength to provide a gradual release of the solvent. If using a compensation member made from expanded polystyrene, the solvent would be an organic solvent, but other materials may entail the use of other solvents. This embodiment too is, however, presently less preferred as it is relatively expensive.

[0042] A third embodiment of the compensation element is shown in Fig. 6 and includes an outer shell 54 and an inner lumen 55 filled with a fluid, preferably water, air or a like cheap and non-polluting substance. When a pre-defined pressure is reached, the outer shell is designed to allow at least some of the fluid to escape, either gradually via openings 56 in the outer shell, by the shell bursting or by a combination thereof. The openings may simply be plugged holes in the outer shell, where the plugs are designed to be forced out of the opening, when a pre-defined pressure is reached, or valves opening and closing depending on the pressure. In this case too, spheres containing a solvent could be embedded in the material of the outer shell so that holes or weakenings are formed when the spheres burst.

[0043] In a fourth embodiment (not shown) the compensation member is simply made from a material, which becomes soft on exposure to water and will therefore loose its bearing capacity on contact with wet soil. Such a compensation member could for example be made from paper or cardboard.

[0044] In the examples described above, the invention has been described with reference to a construction with a single building structure in the form of a ground deck

3, but it is to be understood that the construction may include more building structures and that it need not include a ground deck. Other examples of building structures, which might benefit from the use of compensation members are hollow elements, such as tunnel sections.

[0045] Moreover, it has been the assumption that the soil expands after construction of the building structure, but it may of course also contract, resulting in the ground level being lowered. This will result in a gap between the compensation elements and the ground, but as described with reference to the situation in Fig. 3 this is of no consequence, since the building structure then no longer depends on the support of the compensation elements.

Claims

1. A method for constructing a pile grounded building structure including the steps of:

a) arranging a plurality of piles (10,11,12,13,14) in the ground (4), and
b) constructing the building structure in a manner so that a fixed connection is achieved between it and at least some of the piles,

characterized in that it further includes the following steps to be performed before step b):

c) calculating the expected area weight of the building structure and the resulting compressive force σ_D affecting material underneath the building structure during construction thereof,
d) calculating the breaking strength σ_B of the building structure,
e) calculating the expected maximum soil uplift ε_G of the ground,
f) providing compensation elements (5) having:

- a compressive strength σ_C, which is larger than the compressive force σ_D of the building structure and smaller than the breaking strength σ_B of the building structure, and
- a maximum strain ε_C, which is bigger than the expected maximum soil uplift ε_G of the ground,

g) arranging the compensation elements (5) on the ground , so that they cover the area to be covered by the building structure substantially entirely.

2. A method according to claim 1, where the building structure is made from concrete by in situ casting.

3. A method according to claim 2, where step g) further includes arranging one or more cover element(s) on top of the compensation elements.

4. A method according to any of the preceding claims, where the compensation elements are lamella elements made from mineral wool, which, in step g), are laid close to one another with the primary orientation of the mineral wool fibres of the lamella elements being approximately vertical.

5. A method according to any of the preceding claims, where the compensation elements are laid in a bond pattern and where the cover elements, if any, are laid so that at least some of the joints between them are not directly above parallel joints between compensation elements.

6. A method according to any of the preceding claims, where spacers for holding concrete reinforcement are arranged on at least some of the compensation elements or cover elements, if any.

7. A construction comprising a pile grounded building structure, where at least some of the piles are fixed in the building structure,
characterized in that
compensation elements (5) are arranged between the ground (4) and the building structure, so that they cover the area covered by the building structure substantially entirely, and
that the compensation elements (5) have a compressive strength σ_C, which is larger than the compressive force σ_D resulting from the area weight of the building structure and smaller than the breaking strength σ_B of the building structure, and a maximum strain ε_C, which is bigger than the expected maximum soil uplift ε_G of the ground.

8. A construction according to claim 7, where, in an initial state, the space present between the building structure and the ground is filled substantially entirely.

9. A construction according to claim 7 or 8, where the building structure is made from in situ concrete.

10. A construction according to any of claims 7-9, where the building structure includes a ground deck and/or where upper parts of at least some of the piles project over the ground.

11. A construction according to any of claims 7-10, further including one or more cover element(s) arranged on top of the compensation elements.

12. A construction according to any of claims 7-11, where the compensation elements are lamella elements made from mineral wool, preferably having a density of 30-75 kg/m^3, for stone wool 50-75 kg/m^3, and arranged with a primary orientation of the mineral wool fibres approximately vertically.

13. A construction according to claim 12, where the height of the lamella elements is 50-500 mm, preferably 100-300 mm, the width of the lamella elements is 50-600 mm, and the length of the lamella elements is 1500-2500 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.

14. A construction according to any of claims 7-13, where at least one compensation element includes a weakening zone allowing it to collapse wholly or partially.

15. A construction according to any of claims 7-14, where at least one compensation element comprises an outer shell and an inner lumen filled with a fluid, said outer shell allowing at least some of the fluid to escape when the compensation element is exposed to a pressure larger than the compressive force σ_D resulting from the weight of the building structure.

Patentansprüche

1. Verfahren zum Herstellen einer Gebäudestruktur mit Pfahlfundament, das die folgenden Schritte umfasst:

a) Anordnen mehrerer Pfähle (10, 11, 12, 13, 14) im Boden (4), und
b) Herstellen der Gebäudestruktur derart, dass eine feste Verbindung zwischen ihr und mindestens einigen der Pfähle erhalten wird,

dadurch gekennzeichnet, dass es ferner die vor Schritt b) durchzuführenden folgenden Schritte umfasst:

c) Berechnen des erwarteten Flächengewichts der Gebäudestruktur und der sich ergebenden Druckkraft σ_D, die Material unterhalb der Gebäudestruktur während deren Herstellung beeinflusst,
d) Berechnen der Bruchfestigkeit σ_B der Gebäudestruktur,
e) Berechnen der erwarteten maximalen Erdreichhebung ε_G des Bodens;
f) Bereitstellen von Ausgleichselementen (5), die Folgendes aufweisen:

- eine Druckfestigkeit σ_C, die größer als die Druckkraft σ_D der Gebäudestruktur und kleiner als die Bruchfestigkeit σ_B der Gebäudestruktur ist, und
- eine maximale Belastung ε_C, die größer als die erwartete maximale Erdreichhebung ε_G des Bodens ist,

g) Anordnen der Ausgleichselemente (5) auf dem Boden, derart, dass sie die durch die Gebäudestruktur zu bedeckende Fläche im Wesentlichen vollständig bedecken.

2. Verfahren nach Anspruch 1, wobei die Gebäudestruktur durch Gießen von Ortbeton hergestellt wird.

3. Verfahren nach Anspruch 2, wobei Schritt g) ferner Anordnen eines oder mehrerer Abdeckelemente oben auf den Ausgleichselementen umfasst.

4. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Ausgleichselemente Lamellenelemente sind, die aus Mineralwolle hergestellt sind, die in Schritt g) nahe beieinander verlegt werden, wobei die Hauptausrichtung der Mineralwollfasern der Lamellenelemente ungefähr vertikal ist.

5. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Ausgleichselemente in einem Verbundmuster verlegt werden und wobei die Abdeckelemente, falls welche vorhanden sind, so verlegt werden, dass sich mindestens einige der Verbindungen zwischen ihnen nicht direkt über parallelen Verbindungen zwischen Ausgleichselementen befinden.

6. Verfahren nach einem der vorhergehenden Ansprüche, wobei Abstandsstücke zum Halten von Betonverstärkung auf mindestens einigen der Ausgleichselemente oder Abdeckelemente angeordnet sind, falls welche vorhanden sind.

7. Konstruktion, umfassend eine Gebäudestruktur mit Pfahlfundament, wobei mindestens einige der Pfähle in der Gebäudestruktur befestigt sind,
dadurch gekennzeichnet, dass
Ausgleichselemente (5) zwischen dem Boden (4) und der Gebäudestruktur derart angeordnet sind, dass sie die durch die Gebäudestruktur bedeckte Fläche im Wesentlichen vollständig bedecken, und dass die Ausgleichselemente (5) eine Druckfestigkeit σ_C, die größer als die sich aus dem Flächengewicht der Gebäudestruktur ergebende Druckkraft σ_D und kleiner als die Bruchfestigkeit σ_B der Gebäudestruktur ist, und eine maximale Belastung ε_C, die größer als die erwartete maximale Erdreichhebung ε_G des Bodens ist, aufweisen.

8. Konstruktion nach Anspruch 7, wobei in einem Anfangszustand der Raum zwischen der Gebäudestruktur und dem Boden im Wesentlichen vollständig gefüllt ist.

9. Konstruktion nach Anspruch 7 oder 8, wobei die Gebäudestruktur durch Gießen von Ortbeton hergestellt ist.

10. Konstruktion nach einem der Ansprüche 7 - 9, wobei die Gebäudestruktur ein Bodendeck enthält und/oder wobei obere Teile mindestens einiger der Pfähle über den Boden vorragen.

11. Konstruktion nach einem der Ansprüche 7 - 10, ferner umfassend ein oder mehrere Abdeckelemente, die oben auf den Ausgleichselementen angeordnet sind.

12. Konstruktion nach einem der Ansprüche 7 - 11, wobei die Ausgleichselemente Lamellenelemente sind, die aus Mineralwolle hergestellt sind, die vorzugsweise eine Dichte von 30 - 75 kg/m^3, für Steinwolle 50 - 75 kg/m^3, aufweisen, und mit einer ungefähr vertikalen Hauptausrichtung der Mineralwollfasern.

13. Konstruktion nach Anspruch 12, wobei die Höhe der Lamellenelemente 50 - 500 mm, vorzugsweise 100 - 300 mm, beträgt, die Breite der Lamellenelemente 50 - 600 mm beträgt und die Länge der Lamellenelemente 1500 - 2500 mm beträgt, wobei die Höhe die Dimension ist, die im Wesentlichen parallel zu der Hauptausrichtung der Mineralwollfasern und im Wesentlichen vertikal im ausgelegten Zustand verläuft.

14. Konstruktion nach einem der Ansprüche 7 - 13, wobei mindestens ein Ausgleichselement eine Schwächungszone enthält, die ihm gestattet, vollständig oder teilweise zusammenzufallen.

15. Konstruktion nach einem der Ansprüche 7 - 14, wobei mindestens ein Ausgleichselement einen äußeren Mantel und ein Innenlumen, das mit einem Fluid gefüllt ist, umfasst, wobei der äußere Mantel gestattet, dass mindestens ein Teil des Fluids entweicht, wenn das Ausgleichselement einem Druck ausgesetzt ist, der größer als die sich aus dem Gewicht der Gebäudestruktur ergebende Druckkraft σ_D ist.

Revendications

1. Procédé de construction d'une structure de bâtiment à fondation par pieux, comprenant les étapes suivantes :

a) agencement d'une pluralité de pieux (10, 11, 12, 13, 14) dans le sol (4), et
b) construction de la structure de bâtiment de manière à ce qu'une connexion fixe soit établie entre elle et au moins certains des pieux,

caractérisé en ce qu'il comprend en outre les étapes suivantes devant être effectuées avant l'étape b) :

c) calculer le poids de la surface prévue de la structure de bâtiment et la force de compression résultante σ_D affectant le matériau sous la structure de bâtiment lors de sa construction,
d) calculer la résistance à la rupture σ_B de la structure de bâtiment,
e) calculer le soulèvement du sol ε_G maximum attendu,
f) fournir des éléments de compensation (5) ayant

- une résistance à la compression σ_C, qui est supérieure à la force de compression σ_D de la structure de bâtiment et inférieure à la résistance à la rupture σ_B de la structure de bâtiment, et
- une contrainte maximale ε_C, qui est supérieure au soulèvement du sol ε_G maximum attendu,

g) agencer les éléments de compensation (5) sur le sol, de telle sorte qu'ils couvrent substantiellement entièrement la surface devant être couverte par la structure de bâtiment.

2. Procédé selon la revendication 1, dans lequel la structure de bâtiment est fabriquée en béton coulé sur place.

3. Procédé selon la revendication 2, dans lequel l'étape g) comporte en outre l'agencement d'un ou de plusieurs éléments de recouvrement par-dessus les éléments de compensation.

4. Procédé selon l'une quelconque des revendications précédentes, dans lequel les éléments de compensation sont des éléments de lamelles fabriqués à partir de laine minérale qui, dans l'étape g), sont posés les uns à côté des autres avec l'orientation principale des fibres de laine minérale des éléments de lamelle approximativement verticale.

5. Procédé selon l'une quelconque des revendications précédentes, dans lequel les éléments de compensation sont posés suivant un motif lié et dans lequel les éléments de recouvrement, le cas échéant, sont posés de telle sorte qu'au moins certains des joints entre eux ne soient pas directement au-dessus de joints parallèles entre des éléments de compensation.

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel des éléments d'espacement pour retenir une armature de béton sont agencés sur au moins certains des éléments de compensation ou des éléments de recouvrement, le cas échéant.

7. Construction comprenant une structure de bâtiment à fondation par pieux, dans laquelle au moins certains des pieux sont fixés dans la structure de bâtiment,
caractérisée en ce que
des éléments de compensation (5) sont agencés entre le sol (4) et la structure de bâtiment de telle sorte qu'ils couvrent substantiellement entièrement la surface couverte par la structure de bâtiment, et
en ce que les éléments de compensation (5) ont une résistance à la compression σ_C qui est supérieure à la force de compression σ_D résultant du poids de la surface de la structure de bâtiment et qui est inférieure à la résistance à la rupture σ_B de la structure de bâtiment, et une contrainte maximale ε_C qui est supérieure au soulèvement du sol ε_G maximum attendu.

8. Construction selon la revendication 7, dans laquelle, dans un état initial, l'espace existant entre la structure de bâtiment et le sol est substantiellement complètement rempli.

9. Construction selon la revendication 7 ou 8, dans laquelle la structure de bâtiment est fabriquée en béton coulé sur place.

10. Construction selon l'une quelconque des revendications 7 à 9, dans laquelle la structure de bâtiment comporte une terrasse et/ou dans laquelle des parties supérieures d'au moins certains des pieux dépassent au-dessus du sol.

11. Construction selon l'une quelconque des revendications 7 à 10, comportant en outre un ou plusieurs éléments de recouvrement agencés par-dessus les éléments de compensation.

12. Construction selon l'une quelconque des revendications 7 à 11, dans laquelle les éléments de compensation sont des éléments de lamelles fabriqués à partir de laine minérale, de préférence ayant une densité de 30-75 kg/m^3, et pour de la laine de pierre, de 50-75 kg/m^3, et disposés avec une orientation principale des fibres de laine minérale approximativement verticale.

13. Construction selon la revendication 12, dans laquelle la hauteur des éléments de lamelle est de 50-500 mm, de préférence de 100-300 mm, la largeur des éléments de lamelle est de 50-600 mm, et la longueur des éléments de lamelle est de 1500-2500 mm, la hauteur étant la dimension qui est substantiellement parallèle à l'orientation primaire des fibres de laine minérale et substantiellement verticale dans l'état posé.

14. Construction selon l'une quelconque des revendications 7 à 13, dans laquelle au moins un élément de compensation comporte une zone d'affaiblissement lui permettant de s'affaisser complètement ou partiellement.

15. Construction selon l'une quelconque des revendications 7 à 14, dans laquelle au moins un élément de compensation comprend une coque extérieure et une lumière intérieure remplie d'un fluide, ladite coque extérieure permettant à au moins une partie du fluide de s'échapper lorsque l'élément de compensation est exposé à une pression supérieure à la force de compression σ_D résultant du poids de la structure du bâtiment.

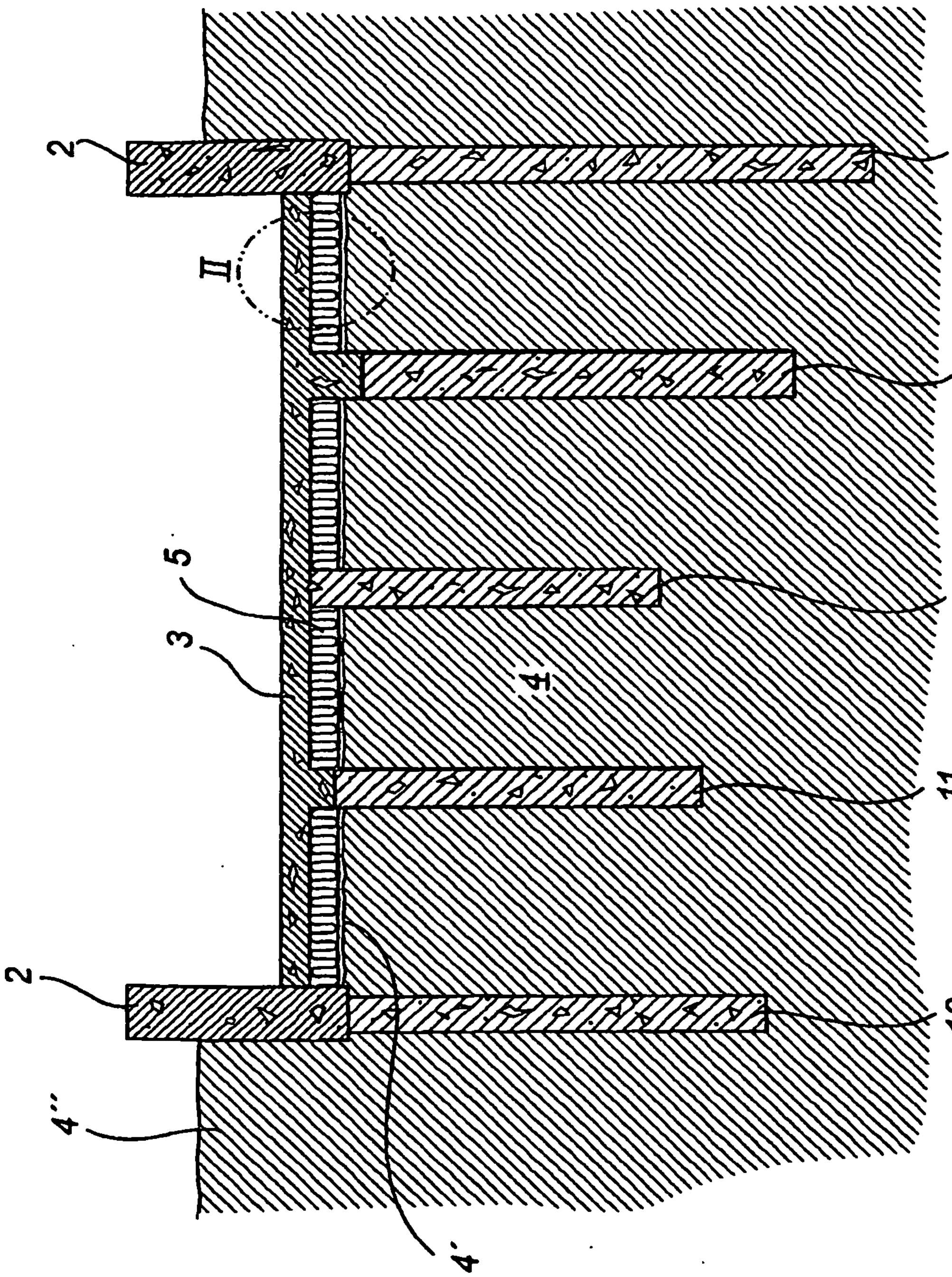

Fig. 1

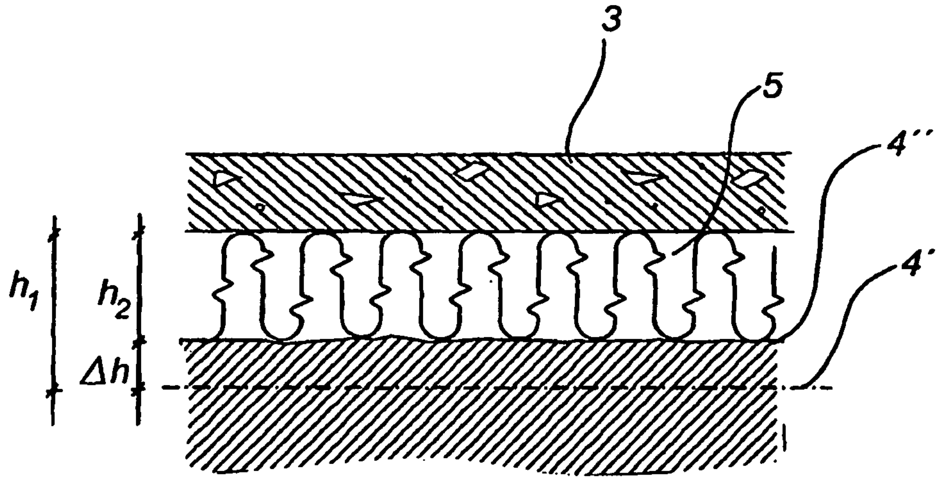

Fig. 2

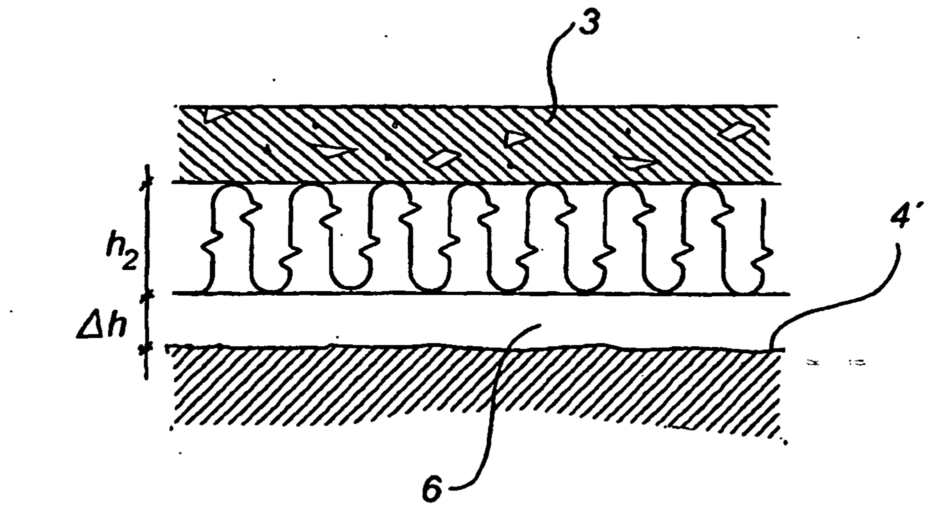

Fig. 3

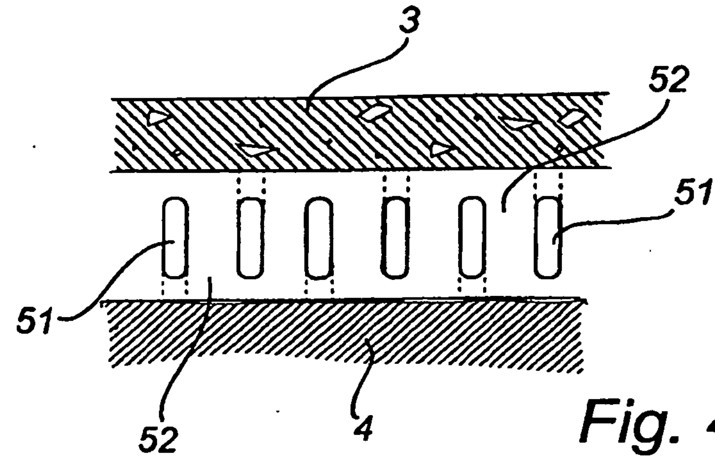

Fig. 4

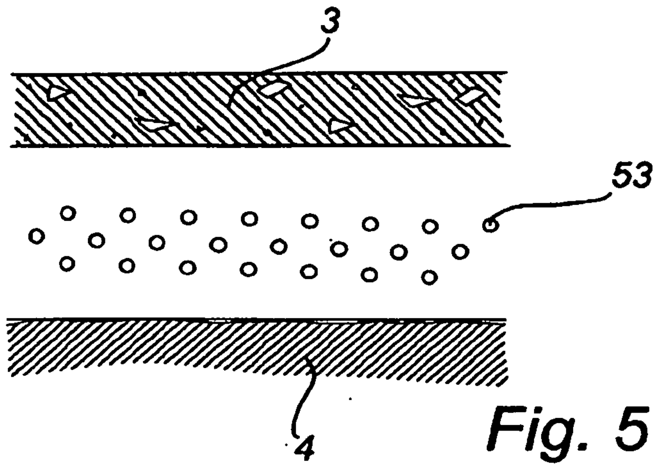

Fig. 5

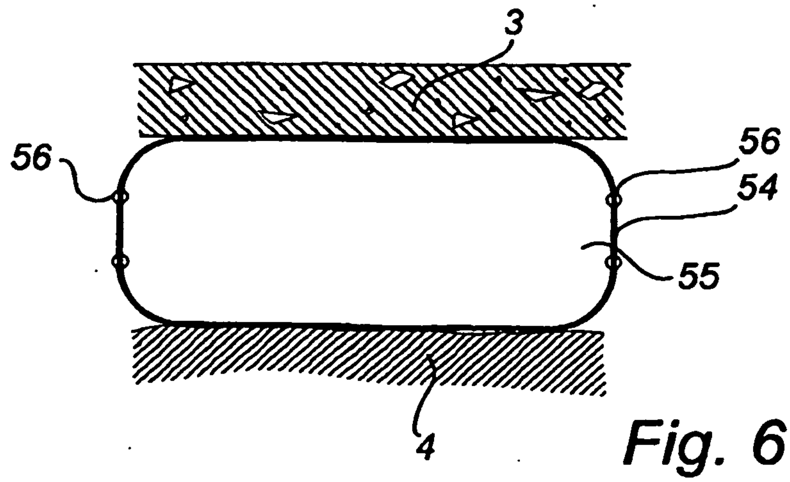

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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