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Remarks:
Amended claims in accordance with Rule 86 (2) EPC.

(54) **Method for creation underground diaphragm walls carried out with control and adjustment of the vertical positions and diaphragm wall so manufactured**

(57) The invention refers to a procedure for constructing diaphragm walls for reinforcing the land and diaphragm wall so manufactured.

The procedure involves constructing diaphragm panels adjacent to each other, continuously controlling and adjusting the verticality (both lengthways and crossways) and subsequently casting the concrete in the dig after positioning an appliance which is fitted with a device to control and adjust the verticality to guarantee perfect adherence between the faces of the joints in adjacent panels.

If required, when faced with extensive pressure or movement of the ground, the procedure provides the use of a flexible joint that guarantees a continuous barrier

The use of the described procedure is essential to guarantee the efficiency of the constructed product.

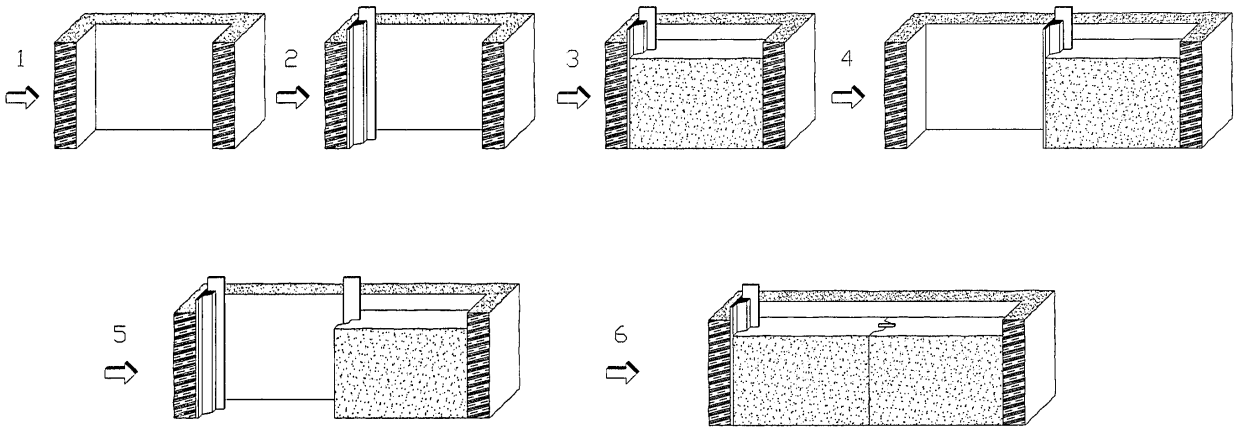

FIG.1

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Description

[0001] The invention that we are requesting an industrial patent registration for involves a procedure for making underground diaphragm walls with control and adjustment of the verticality and the diaphragm wall so manufactured.

TECHNICAL FIELD

[0002] The application field for this invention is geotechnical engineering for special foundations for constructions underground and in particular the construction of diaphragm walls.

BACKGROUND ART AND TECHNICAL PROBLEM TO BE SOLVED

[0003] In geotechnics, underground diaphragm walls have been used for years as supports for the dig walls and/or waterproofing the land.

[0004] Traditional procedures involve constructing single elements, called panels, which can be made by casting concrete in a dig of the same size as the panel, and which usually has metal reinforcement.

[0005] The single panels are then lined up along the longest side, either in sequence or alternated.

[0006] The current techniques used for making the diaphragm walls are:

a) Diaphragm wall with a normal, temporary joint, made between a succession of panels with a shaped pipe or metal sections of various shapes;
b) Diaphragm wall with a joint between the succession of panels, waterproofed by injecting various types of mixtures in various manners on the outside of the diaphragm wall at the point of the joint;
c) Diaphragm wall with a joint between the succession of panels, waterproofed by injecting various types of mixtures in the cavity that is made vertically in correspondence with the join, which is made by perforating the diaphragm walls or by burying pipes in the cast.
d) Diaphragm wall with a joint between successive panels, waterproofed by burying a waterproof element of varying shape, size and material in the cast in correspondence with the join.

[0007] The solutions given above all have critical points, which, generally and in certain conditions, make the product ineffective.

Solution a) is characterised by the fact that the joints are, in fact, an "interruption in the cast" which, under the deformation pressure induced in the diaphragm panels, during the digging work and/or after the construction is in place, could create water percolation from outside the diaphragm wall,

Solution b) first of all has a technical-quality problem: the fact the waterproofing substance does not penetrate inside the joint, and the waterproofing substance does not adhere perfectly to the wall of the diaphragm meaning that the joints are not guaranteed as efficient.

[0008] It is also a very costly operation, as it is lengthy to carry out and involves working in a number of phases.

[0009] Solutions c) and d) are theoretically practicable, but require four conditions for them to be effective, which traditional procedures do not guarantee:

1. The panels must be vertical;
2. The faces of the joint must be clean;
3. The surfaces of the joint must be smooth;
4. The drilling and pipe burying is performed with very narrow geometric tolerances.

[0010] If one or more of these conditions is not satisfied, the joint could be faulty and therefore be the cause of leaks even of a certain entity, with the possible removal of the fine part of the soil, with the risk of collapse in the areas and buildings situated near to the intervention point.

[0011] In all cases, the solutions do not consider the geometric tolerances in applying the intervention in the areas of the joint. In cases c) and d), the material the joint is made of is not flexible which is needed to absorb the deformation in the diaphragm wall during the various digging phases.

AIM OF THE INVENTION

[0012] The technique used to make the diaphragm wall using the procedure provided by the invention, would guarantee continuous diaphragm walls, as they are made controlling the verticality and laying flexible joints.

[0013] The effectiveness of the joints is guaranteed by the following features of the diaphragm wall: verticality and coplanarity of the panels, clean even surfaces on the joints between adjacent panels.

[0014] The effectiveness of the joints is also guaranteed even when the diaphragm wall is subject to stress which could cause deformation, thanks to the flexibility of the joint which adapts to the deformation without breaking.

PROCEDURE AND DESCRIPTION OF THE DRAWINGS

[0015] The construction sequence provides the following phases, which are shown in the diagram in figure 1:

PHASE (1): Dig the opening panel using the special digging equipment; Figure 1 (1);
PHASE (2): Lay the special metal equipment in the dig (joint holder) which carries the joint; Figure 1 (2)

PHASE 3: Lay the reinforcement and cast the diaphragm wall panel; Figure 1 (3)
PHASE 4: Dig the adjacent diaphragm wall panel in the same manner as phase 1, controlling and adjusting the verticality using the joint holder which is fitted with a control device that continuously controls the verticality and another device to adjust it if needed; Figure 1 (4);
PHASE 5: Removal of the joint holder when the dig is finished, releasing the flexible joint and leaving a clean surface in contact with the constructed panel, ready for casting the next one. Along the opposite shorter side, position the joint holder with a new joint as described in the procedure in phase 2; Figure 1 (5);
PHASE 6: lay the reinforcement and cast the concrete; Figure 1 (6).

[0016] This diaphragm wall has the verticality controlled and adjusted and has the following technical advantages:

1) Continuity in the various diaphragm wall panels
2) Correct and even adhesion of the concrete in the area around the joint on the previously constructed panel;
3) Long-lasting watertight diaphragm walls around the joint, thanks to the very strong flexible vertical joint, which resists even when the diaphragm walls deform.

Claims

1. Procedure for the construction of continuous vertical diaphragm walls formed of panels that are made with control and adjustment of the verticality of the dig, using the metal joint holder on the shorter side.

2. Procedure according to claim 1), **characterised by** the fact that the dig is made using a hydraulic bucket with a metal guide on the bottom side of the dig, adjacent to the previously constructed panel; the metal device follows the entire depth of the dig.

3. Procedure according to claim 2, **characterised by** the fact the verticality is controlled and adjusted during the digging phases using a metal guide (joint holder) which has devices installed for controlling the verticality and adjusting the geometry.

4. Procedure according to claim 1) **characterised by** the fact that it provides digging the ground down to the planned depth, removing the joint holder by an oil-pressure device when the digging is finished, and repositioning the joint holder on the opposite side of the dig.

5. Procedure according to claim 1) **characterised by** the fact that it provides a flexible joint in the joint holder, positioning the joint holder in the dig on the short side opposite the previously constructed panel and releasing the joint after the concrete has been cast and hardened.

6. Diaphragm wall made according to the procedure described in claims 1-2-3-4-5 **characterised by** the fact the final product has the following features: vertical panels; coplanar panels; clean faces on the joint between adjacent panels; even surfaces on the joint.

7. Diaphragm wall made according to the procedure described in claims 1-2-3-4-5 **characterised by** the fact the diaphragm wall is continuous because a flexible joint is laid joined to the two adjacent panels.

Amended claims in accordance with Rule 86(2) EPC.

1. Procedure for the construction of continuous vertical diaphragms formed of panels (Fig. 1) that are made with the control and adjustment of the verticality of the dig, using a metal guide joint holder (Fig. 2) on the short side of the dig. The dig is made using a hydraulic bucket with the metal guide joint holder on the shortest side of the dig, following the entire depth of the dig, adjacent to the previously constructed panel, **characterised by** the fact that verticality is regulated and controlled using the metal guide joint holder, which is equipped with special continuous measuring instruments for the dig verticality and another device that adjusts the verticality when required; this device is formed of oil-pressure jacks (or other types of actuators) that can change the position of the metal guide joint holder during the digging phases.

2. Procedure according to claim 1, **characterised by** the fact that the metal guide joint holder is formed of: a) a metal structure, figure 2 (1) of a suitable shape to cover the entire width of the dig (shorter side) and hold all the measuring and adjustment devices; b) continuous measuring instruments for the verticality, placed on the bottom of the metal guide joint holder - figure 2 (2); c) oil-pressure devices (or any sort of actuators) for adjusting the verticality of the metal guide joint holder inside the dig - Figure 2 (3).

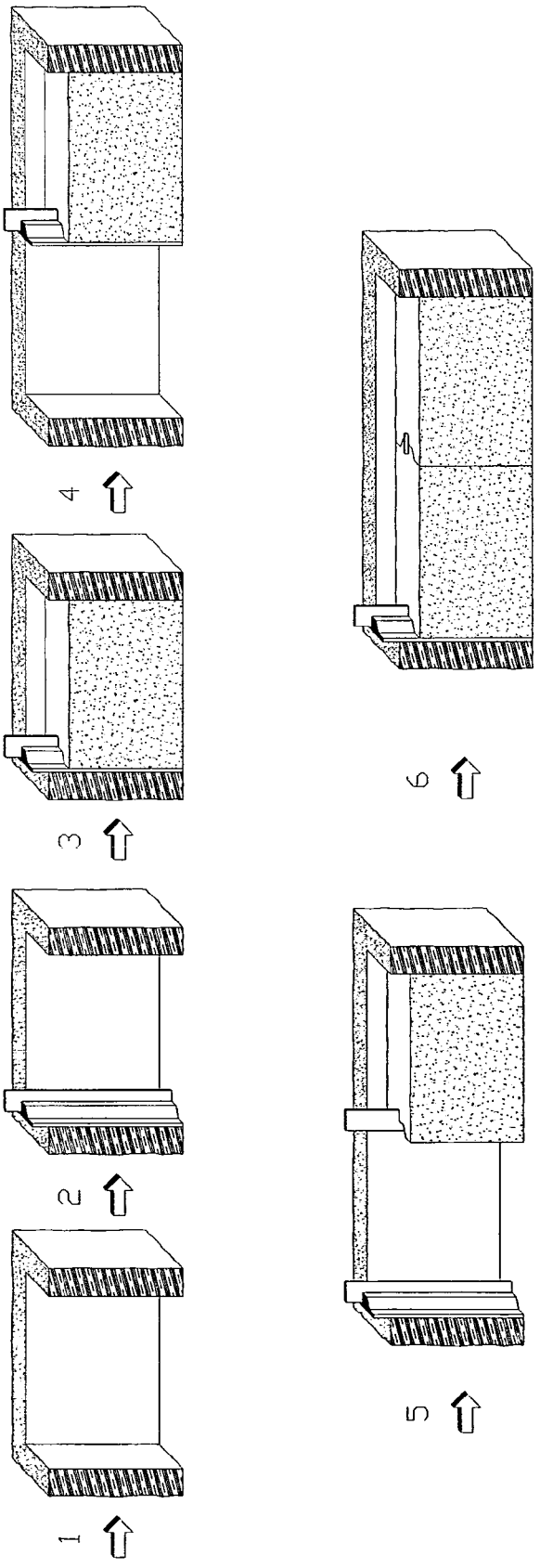

FIG.1

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EUROPEAN SEARCH REPORT

Application Number
EP 06 42 5003

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)

E02D
E02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 March 2006	Kergueno, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 42 5003

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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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82