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(56) Documents Cited
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(54) Reinforced concrete retaining wall structure

(57) An anchored, precast, reinforced concrete retaining wall structure, with controlled tension, which contains one or several concrete dead masses 4 in the back filler material, joined to the facing wall 1 by means of a rigid, threaded element 3 that allows tension regulation, which is verified by means of a dynamometric torque wrench. The wall structure is designed with a support element 2 in its footing, predetermined for a height lower than the height of the wall, which allows a first-stage extrados filling 5 up to the level of the dead mass.

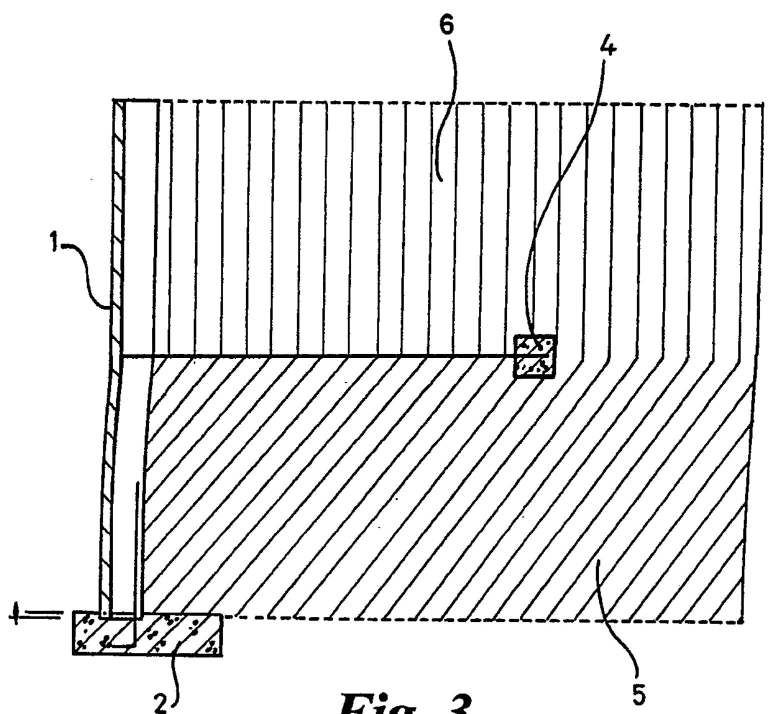

Fig. 3

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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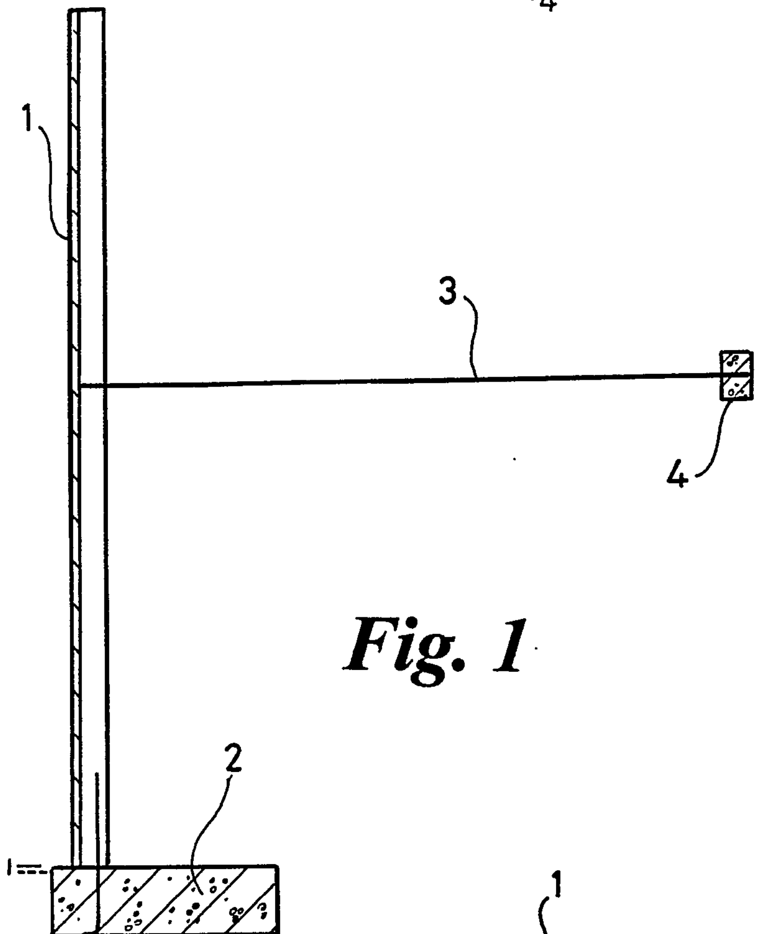

Fig. 1

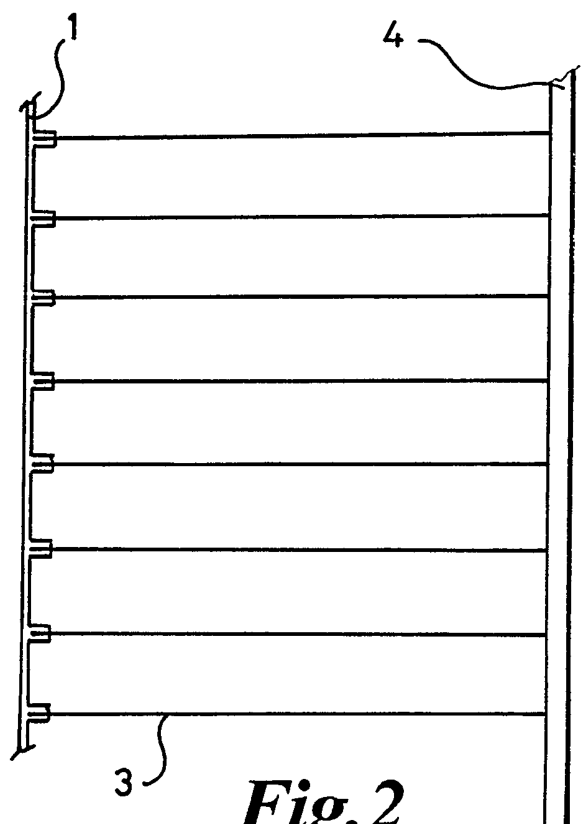

Fig.2

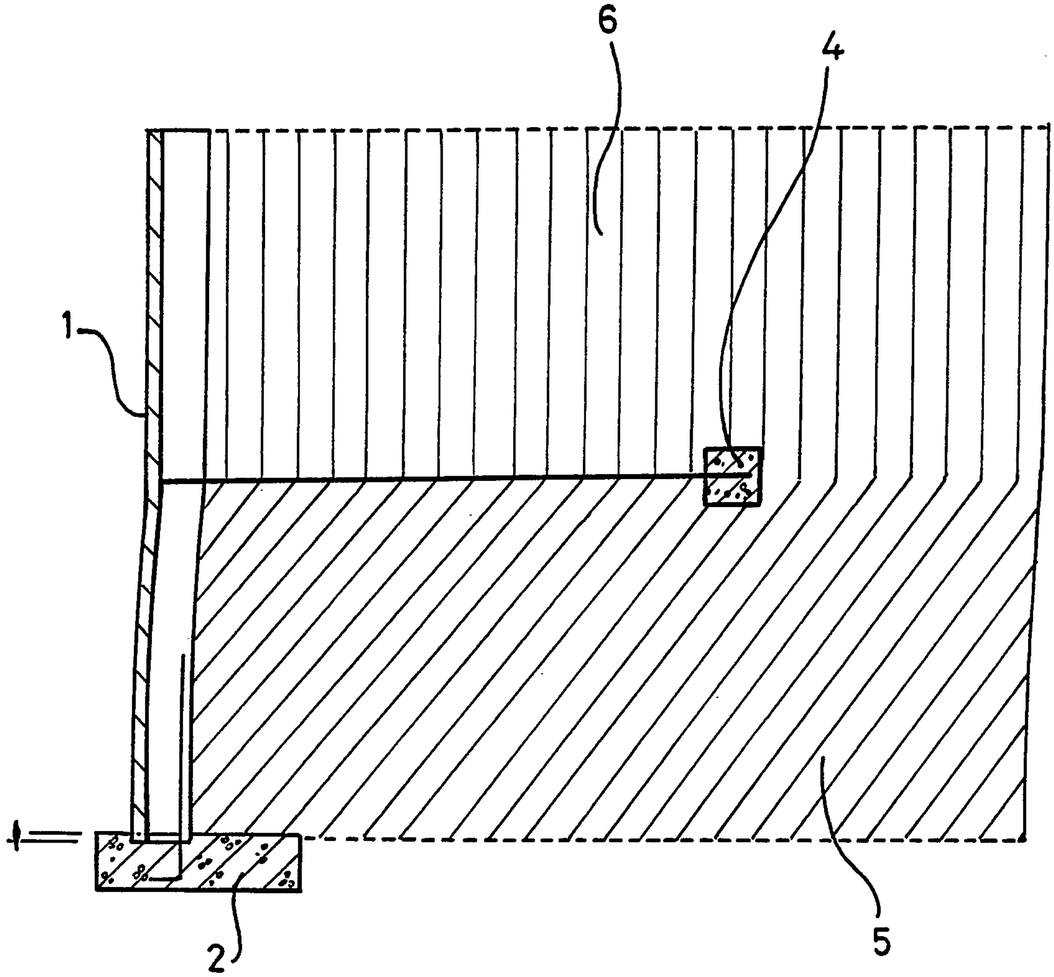

Fig. 3

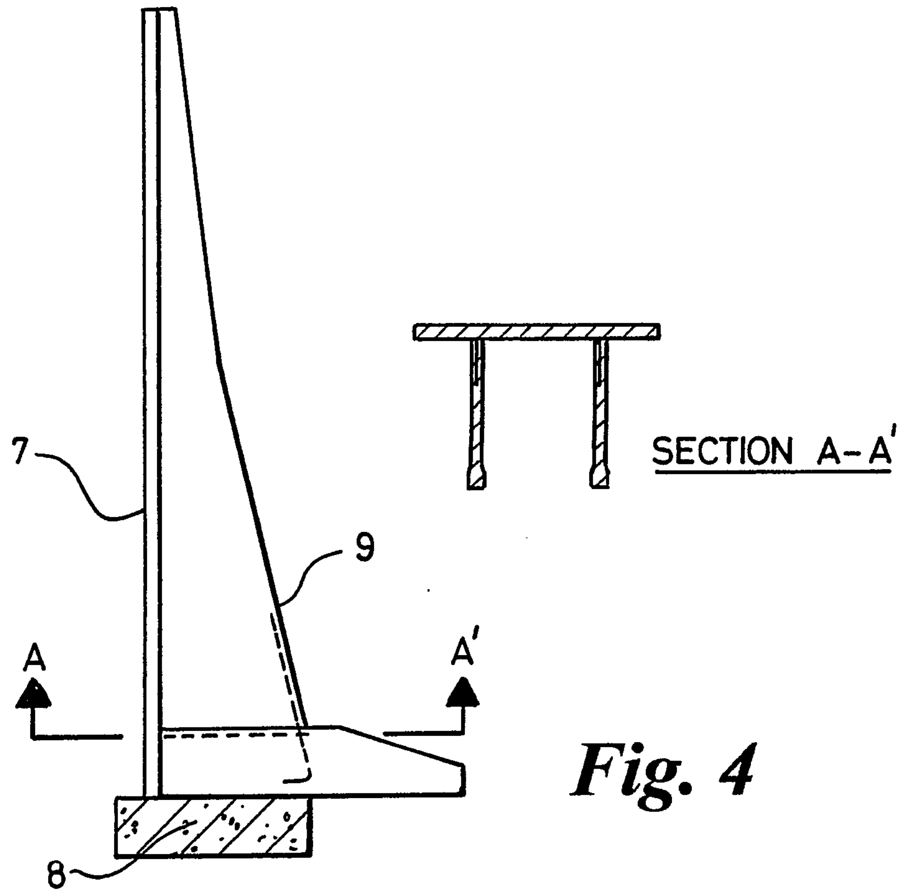

Fig. 4

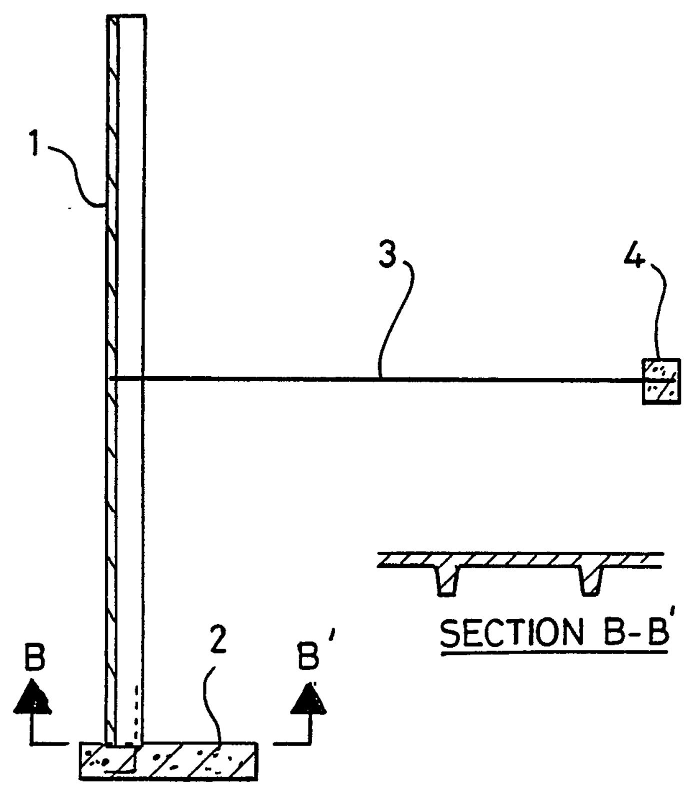

Fig. 5

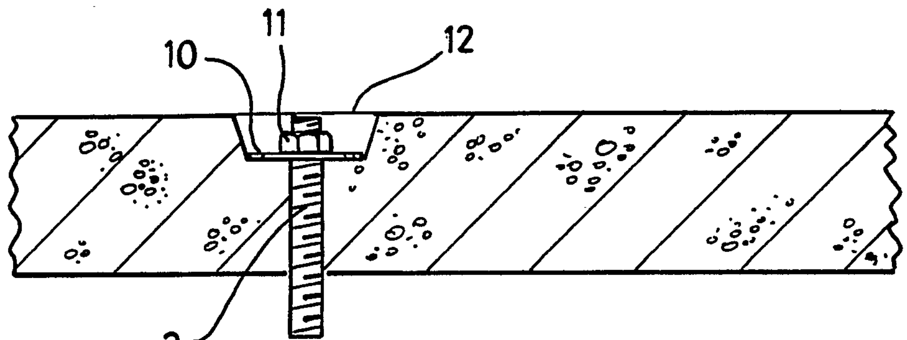

Fig. 6

Title Reinforced Concrete Retaining Wall Structure

The present invention relates to a reinforced retaining wall structure, more especially using precast concrete wall technology.

At present there is an increase in the use of precast ground retaining wall structures, sometimes referred to as bridge abutment systems. The present invention more especially concerns systemised industrialisation of these structures and, in general, manufacture of component parts at a location different to the place where the wall structure is finally to be built.

The systems used at present can be divided into two main groups. The first refers to that which is often called "ground reinforcement", wherein elements are mixed or inserted into the earth, thereby to impart artificial cohesion to the soil which permits it to stand with a vertical or almost vertical face. These elements are usually reinforced with a surface element, sometimes called the shell or skin, that prevents the mass of the system from surface crumbling. There are many variations of this technique, depending on the type and characteristics of the inserted elements, which can be metal or plastic or textiles, for example, sometimes in the form of strips or bands.

The second system often used is the more classic, which employs counterfort or abutment walls. In this system, a facing wall is manufactured and joined before or after erection of abutments. The unit is placed on the job site by means of cranes and shoring and then the foundation footing concrete is poured. Once the concrete footing has set, the extrados of the wall can be filled-in. There are many variations of this system, depending on the type of counterfort, continuous with or separated from the facing panel and depending if the facing wall and counterfort are manufactured at the same time or not. On occasions, they are joined afterwards and, in some cases, the footing is cast, only affecting the counterforts, and the facing wall, consisting of one or several parts, is sited between the counterforts. As stated, the number of variations is enormous and it is impossible to give even a summarised description here of all the systems currently in use. For low walls, for example, it is standard practice to cast the panel and counterfort in the factory, together with the footing.

Within the existing systems, some are based on anchoring or supporting the facing wall to areas existing behind the filling. For example, concrete facing walls, generally made in situ, are frequently anchored to extrados rock areas. There exist special techniques that perforate the rock, introduce a bolt and fasten or anchor the facing wall to the rock. Normally, this is not done with precast walls, although it is evident that the precast walls could be anchored. Another known system involves utilisation of anchors by means of introducing dead masses in the form of square blocks or plates in the extrados filler in a metal sheetpile wall structure.

The conventional system having a facing wall uses counterforts cast to a footing, which results in the facing wall and counterfort working, structurallyspeaking, as a cantilever. This manner of working is very inefficient and has very high material costs.

The present invention primarily consists of having the facing wall and counterfort assembly working together embedded in the footing, but also fastened at some intermediate point. The invention does not require ground reinforcement and has nothing to do with known ground reinforcement techniques. The invention exclusively concerns facing walls of concrete material, which have slight but definite deformation capacity, but the invention provides a solution to this problem.

The invention is best briefly described with reference to the accompanying drawings, wherein Figure 1 represents a cross-section of the proposed wall and Figure 2 is a top view of a section of this wall. From the relative sizes and dimensions illustrated, the very important net savings obtained in materials can be appreciated. Figure 3 shows the building process employed in the present invention, illustrating the dimensions of the footing, to scale, for a typical wall height chosen as an example. The footing has been sized for half of the total height of the wall. In this way, the construction process can be started in situ in the same way as when using any other conventional precast facing wall, with the particularity of obtaining a very substantial decrease in the footing's dimensions. Figure 4 shows a wall, with conventional footing, for the same height, and also illustrates the cantilever reinforcement that the wall must contain. By comparison, Figure 5 shows the footing employed in this invention, for the same safety coefficient. By examining Figure 3, it can be seen that the extrados behind the wall is filled-in with the footing up to half of the height of the wall, without surpassing any calculated safety coefficient. Once half of the wall height has been reached with the filler, a dead mass or reinforced concrete block (precast or made in situ) is placed in the indicated position, in other words, at a sufficient distance from the active buoyancy wedge adjacent to the footing, to which a galvanized steel bolt (having sufficient diameter required for the calculated conditions) is attached. This bolt acts as a "tension bar" and serves as the wall anchor. Then, backfilling and compacting of the dead mass towards the facing wall is continued, to avoid the movement of the dead mass. Depending on how the second stage of backfilling is carried out, the wall assembly will behave correctly. It is possible that the facing wall could move slightly, without this representing any safety loss, and only in the case that the backfilling is not done sufficiently carefully. Figure 6 shows a detail of the system used to anchor the bolt to the panel, which allows subsequent tension adjustment. Once the wall is finished, the tension adjusted and its stability checked, filling in is completed to cover the work, so that no remains of the process can be seen.

The invention as described in an exemplary manner represents a very great improvement in the cost of retaining walls. The level of savings for higher walls, of six metres, for example, is approximately fifty percent.

A particular improvement obtainable with this invention consists of exact control of the tension of the tension bar. By carrying out this control, any possible movement that could have negative effects, primarily from an aesthetic point of view, disappears.

The tension of the bar can be controlled by means of a dynamometric torque wrench, which sets the grip torque. The working tension of the bolt can be set, based on the torque, to coincide with the calculated tension. In other words, this further feature of the invention means that, for the first time, earth retainment structures and bridge abutments can be built with an almost exact knowledge of the working tension of the structure. It is general knowledge that the soil thrust can be calculated using semi-empirical methods, generally based on out-dated equations, which do not take building processes into account, such as compacting or the true characteristics of the filling. With the invention as above exemplified, manner of operation of the structure can be controlled to a greater extent, which represents a very important advance in the field of retainment engineering.

For a better understanding of the different drawings accompanying this specification, a more complete description now follows:-

Figure 1 represents a cross-section of the facing wall 1 wherein the footing 2 in which the wall is embedded can be seen, as well as the bolt 3 that acts as a tension bar and the dead mass 4 of reinforced concrete;

Figure 2 is a top view of a wall section 1 in which the different tension bars that control the facing wall can be seen;

Figure 3 shows the building process for the wall structure, including the facing wall 1, the corresponding footing 2, the extrados filling 5 up to half the wall height, the dead mass 4 and the remaining filler 6 which prevents movement of the dead mass 4;

Figure 4 shows a wall 7 with conventional footing 8 wherein a counterfort, which acts as a cantilever, can be seen, and which the wall structure must essentially contain;

Figure 5 shows the difference in footing size between a wall built in accordance with the present invention and that of Figure 4, and in particular the decrease in the size of the counterfort that is now doubly supported by the footing and the anchoring;

Figure 6 shows the joining of the counterfort and the anchoring, including bolt 3, the distribution washer 10 and the nut 11 that remain inside of the work cup 12, which is filled with cement once the work tension has been regulated and stabilisation controlled, and it will be given the same finish as the rest of the surface of the facing wall.

Various modifications of the above-described and illustrated wall structure are possible within the scope of the invention defined in the following claims.

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Claims

1. A reinforced concrete retaining wall structure having controlled tension, comprising a facing wall and one or more anchoring masses in the wall filler behind the facing wall, joined to the facing wall by means of one or more coupling elements, the arrangement being such that the immobility of the anchoring mass or masses ensures the stability of the facing wall, without requirement for earth reinforcement.

2. A structure according to claim 1, wherein the anchoring mass or masses are of solid concrete, precast or cast in situ.

3. A structure in accordance with claim 1 or claim 2, having a support footing in the base, predesigned for a height lower than the height of the facing wall, which allows a first-stage extrados filling up to the level of the one or more anchoring masses.

4. A structure in accordance with any of the preceding claims, wherein the or each coupling element between the facing wall and the anchoring mass or masses is or are made of galvanized steel, which coupling or coupling elements can be tightened, with consequential movement of the anchoring mass or masses, as necessary, to control the earth's passive thrust.

5. A structure in accordance with any of the preceding claims, wherein the torque control and consequently the

tension of the coupling elements is verified by means of a dynamometric torque wrench or like device.

6. A structure in accordance with any of the preceding claims, employing one or more non-rigid coupling elements such as cables or the like, tension being controlled by torque devices.

7. A reinforced concrete retaining wall structure substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

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Application number
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Relevant Technical Fields (i) UK Cl (Ed.M) E1F: FWDJB; E1H: HJA, HJB (ii) Int Cl (Ed.5) E02D	Search Examiner D B PEPPER
	Date of completion of Search 15 AUGUST 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1 TO 7

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2199603 A	(JONES)	1-3, 6
X	GB 2156871 A	(SEC OF STATE FOR TRANSPORT)	1, 3-5
X	EP 0050166 A	(BALLAST-NEDAM)	1, 3-6
X	US 4952098	(GRAYSON ET AL)	1-3
X	US 4564316	(HUNZIKER)	1, 3-5
X	US 4154554	(HILFIKER)	1-3

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