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Description

BACKGROUND OF THE INVENTION

This invention relates to a method of forming a fixed structure adapted to bear a laterally acting load, on a support, which may be used for example as a retaining wall for a river bank or as a dam wall. Such a method is known from WO-A-8101722, for example.

SUMMARY OF THE INVENTION

According to the invention there is provided a method of forming a fixed structure adapted to bear a laterally acting load on a support, from an elongate tube of a flexible plastic or plastic laminate material divided by dividing walls of a flexible plastic or plastic laminate material into a plurality of compartments running the length of the tube so that the elongate tube divided by dividing walls has a honeycomb structure, comprising the steps of:

- (a) locating the tube in position on the support with one end of the tube above the other end of the tube and with the compartments running in a direction transverse to the direction of the load;
- (b) passing rods or the like through the elongate tube either all in direction transverse to the axes of the compartments or all in a direction parallel to the axes of the compartments or some in a direction transverse to the axes of the compartments and the remainder in a direction parallel to the axes of the compartments, the rods or the like being spaced from one another;
- (c) fixing the rods in position; and
- (d) filling some or all of the compartments with a suitable filler material so that at least some of the compartments are adjacent two or more other compartments filled with the filler material to support and be supported by the adjacent compartments.

According to another aspect of the invention, there is provided a method of forming a fixed structure adapted to bear a laterally acting load on a support from an elongate tube of a flexible plastic or plastic laminate material divided by dividing walls of a flexible plastic or plastic laminate material into a plurality of compartments running the length of the tube so that the elongate tube divided by dividing walls has a honeycomb structure, comprising the steps of:

- (a) fixing a plurality of anchor means into the support;
- (b) locating the tube in position on the support with one end of the tube above the other end of the tube and with the compartments running in a direction transverse to the direction of the load;

(c) locating rods or the like in some or all of the compartments with one end of each rod or the like being attached to an anchor means and with the other end of each rod or the like protruding from the top of the compartments;

(d) passing rods or the like through the elongate tube in a direction transverse to the axes of the compartments, the rods or the like being spaced from one another and fixing the rods or the like in position;

(e) filling some or all of the compartments with a suitable filler material so that at least some of the compartments are adjacent two or more other compartments filled with the filler material to support and be supported by the adjacent compartments; and

(f) placing a rigid member on top of the tube with the free ends of the rods or the like which are located in the compartments fixed into or passing through the rigid member.

According to a further aspect of the invention, there is provided a fixed structure made by one or other of the methods described above.

The fixed structure constructed by the methods described above to bear a laterally acting load may be for example, a retaining wall adapted to retain earthworks such as river banks, or a retaining wall adapted to retain water, i.e. a dam wall.

The elongate tube divided by dividing walls into compartments has a honeycomb structure. In other words, each compartment of the elongate tube comprises a cell in a honeycomb structure. Each cell may have a round, square, diamond, hexagonal or octagonal shape or any other suitable shape.

The flexible material may be either a flexible plastic material or a flexible plastic laminate material. The plastic material may be a conventional plastic material, a biaxially oriented plastic material, or a woven or non-woven fabric. Suitable plastics include high and low density polyethylene, polypropylene, styrene-based plastics, polyesters and polyvinyl chloride. The plastic laminate material may be any suitable laminate wherein one layer at least is a plastic material. Preferably the plastic laminate material comprises a thin metal foil or sheet such as aluminium sandwiched between two sheets of a plastic material as described above.

The elongate tube having the honeycomb structure may be made, for example, by the method described in United States Patent No. 4,478,659. This patent discloses, inter alia, a method of joining a first sheet of two sheets of a non-magnetic material which are joined to each other along a join line to the third sheet of a non-magnetic material along a join line. This method comprises the steps of locating the three sheets close to a magnet with a third sheet adjacent the

first sheet, locating a body which is attracted by the magnet between the first sheet and the second sheet so that the first sheet and the third sheet are brought together in a zone between the magnet and the body with the second sheet below the body, causing the first sheet and the third sheet to be moved through the zone, and joining the third sheet to the first sheet in the zone or immediately after the third sheet and the first sheet have passed through the zone to form the join line. Generally the first sheet and the second sheet are joined to each other along two substantially parallel join lines and the third sheet is joined to the first sheet along a join line which is intermediate the join lines of the first and second sheets. The result of this is a honeycomb structure. The sheets may be joined to each other by heat welding or by ultrasonic welding which creates a continuous welded join line along the length of the sheets. Thus, each compartment of the elongate tube comprises a cell in the honeycomb structure formed between two adjacent sheets of a suitable material.

The cross-section or area of each cell of the honeycomb structure may vary according to the use to which the fixed structure is to be put. Generally, each cell will have a diameter of 100 mm to 1 meter or larger.

Where the flexible material comprises a flexible plastic material, it may comprise a plastic film having a thickness of 50 μm to 500 μm . The length of the elongate tube may be any desired length, for example, 1 meter to 1000 meters.

The flexible material may be micro-perforated to permit the egress of liquid from the tube but not the egress of the particulate filler material.

In step (a) of the first method of the invention, the tube is located in position on the support with one end of the tube above the other end and with the compartments running in a direction transverse to the direction of the load. For example, where the fixed structure is a dam wall, the tube will be located in a substantially vertical position, i.e. with the axes of the compartments being substantially vertical. Where the fixed structure is a retaining wall for earthworks or the like, the tube may either be substantially vertical or may be positioned at an angle to the vertical which is less than 90° . The load will generally act horizontally on the fixed structure.

In step (b) of the first method of the invention, rods or ties or the like are passed through the elongate tube either all in a direction transverse to the axes of the compartments or all in a direction parallel to the axes of the compartments or some in a direction transverse to the axes of the compartments and the remainder in a direction parallel to the axes of the compartments. Thus, the rods may be located in a direction which is transverse to

the axes of the compartments and which is either not transverse to or transverse to the direction of the load, and thus two sets of rods may be used, which sets are both transverse to the axes of the compartments, with one set being not transverse to the direction of the load and the other set being transverse to the direction of the load so that the sets intersect with each other to form a grid-type structure. Alternatively, or in addition, the rods may be located parallel to the axes of the compartments, i.e. the rods are located in some or all of the compartments. Thus, to summarise, the rods may be transverse to the axes of the compartments and not transverse to the direction of the load, or transverse to the axes of the compartments and transverse to the direction of the load, or parallel to the axes of the compartments, or any combination of the above.

In step (c) of the first method of the invention, the rods are fixed in position. When the rods are transverse to the axes of the compartments, and not transverse to the direction of the load, the rods may be attached to a support structure located outside the tube, either on one or both sides of the tube. For example, the support structure may be a scaffolding structure or the like. As an alternative, the outer compartments of the tube may be filled with a material which sets such as cement or concrete, thus holding the rods in position. As a further alternative, the rods may be attached to stays, which in turn are anchored to the ground. When the rods are transverse to the axes of the compartments and transverse to the direction of the load, the rods may be attached to a support structure located outside the tube or to a fixture located in the vicinity of the tube. For example, when the fixed structure comprises a dam wall, the rods may be attached to the rock faces or the like forming the sides of the dam wall.

When the rods are parallel to the axes of the compartments, each rod may be attached at one end to an anchor means attached to the support, with the other end of the rod protruding from the top of the compartment. Thereafter, after the compartments have been filled with a filler material, a rigid member such as a cast concrete slab may be placed on top of the tube. The free ends of the rods may either be embedded in the rigid member during its formation or thereafter, or may pass through the rigid member so that they protrude on top of the rigid member. This may be desirable where it is desired to tension the rods to impart a compressive load to the structure.

In step (d) of the first method of the invention, some or all of the compartments of the tube are filled with a suitable filler material. The filler material may be any suitable material such as sand, cement, crushed stone, a particulate-containing

sludge or slurry, mine tailings, fly ash, river bed sediment, or bentonite or a mixture of two or more thereof. The preferred filler material is a mixture of sand or fine milled stone with bentonite, preferably 4 - 10 % by weight of bentonite. The fixed structure constructed by the method of the invention gains its great strength under a laterally acting load because of the fact that most or all of the compartments are adjacent two or more other compartments which are also filled with the filler material. Thus, each compartment supports and is supported by its adjacent compartments. This prevents the compartments from rupturing as they are simultaneously supported by their neighbours and provide support to their neighbours.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic side view of a dam wall constructed according to a method of the invention;

Figure 2 is a plan view of the dam wall of Figure 1;

Figure 3 is a schematic perspective view of a retaining wall constructed according to a method of the invention; and

Figure 4 is a schematic side view of another dam wall constructed according to a method of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figures 1 and 2, a dam wall 10 is formed between two rock faces 12 and 14. The dam wall 10 is adapted to bear a laterally acting load illustrated by the arrow A.

The dam wall 10 is constructed from an elongate tube 16 of a flexible plastic or plastic laminate material divided by dividing walls of a flexible plastic or plastic laminate material into a plurality of compartments 18 running the length of the tube 16. The compartments 18 form the cells of the honeycomb structure. Rods 20 are passed through the compartments 18 in a direction which is substantially parallel to the direction of the laterally acting load indicated by the arrow A. The rods 20 are attached to a scaffolding structure 22 located on either side of the tube 16. The compartments 18 of the tube 16 are filled with a suitable filler material such as river bed sediment.

The dam wall 10 is constructed as follows. Firstly, the elongate tube 16 is located in position between the rock faces 12 and 14. The elongate tube 16 may be attached to the rock faces 12 and 14, if desired, to support it. Thereafter, the rods 20 are passed through the elongate tube 16. The elongate tube 16 may include pre-punched holes

through which the rods 20 can be passed. As an alternative, the rods 20 may have sharpened ends or heated ends and may pierce the elongate tube as they are pushed therethrough. The rods 20 are then attached to the scaffolding structure 22 located on either side of the tube 16 so that the tube 16 is supported in position. Finally, some or all of the compartments 18 of the tube 16 are filled with a suitable filler material.

The dam wall 10 has great strength under a laterally acting load because of the fact that most or all of the compartments are adjacent two or more other compartments which are also filled with a particulate filler material. This prevents the compartments from rupturing as they are simultaneously supported by their neighbours and provide support to their neighbours.

Referring to Figure 3, a retaining wall 30 for a river bank 32 comprises an elongate tube 34 of a flexible plastic or plastic laminate material divided by dividing walls of a flexible plastic or plastic laminate material into a plurality of compartments or cells 36 running the length of the tube 34. Rods 38 pass through the tube 34 in a direction transverse to the axis of the compartments 36. The rods 38 are fixed in position by means of cement which is located in the compartments 36A. The other ends of the rods 38 are located in the earth of the river bank 32. The rest of the compartments 36B of the elongate tube 34 are filled with a suitable filler material.

The retaining wall 30 is constructed as follows. The elongate tube 34 is located in position at an angle of less than 90° to the vertical. The rods 38 are passed through the compartments 36 of the elongate tube 34 in a direction which is not parallel to the direction of the laterally acting load B but which is at an angle thereto and which direction is transverse to the axes of the compartments 36. The rods 38 are then fixed in position by pouring cement into the outer compartments 36A of the elongate tube 34. Thereafter, the remainder of the compartments 36B of the elongate tube 34 are filled with a suitable filler material.

As an alternative to the compartments 36A being filled with a cement or the like, a cladding sheet made of metal, wood, asbestos filled cement, concrete or the like may be located on the outside of the elongate tube 34 and the rods 38 may be attached to the metal cladding sheet to hold them in position.

Again, the retaining wall 30 is capable of bearing a laterally acting load because of the fact that most or all of the compartments are adjacent two or more other compartments which are also filled with filler material.

Referring to Figure 4, a dam wall 40 is formed between two rock faces 42 and 44 and on a sup-

port or base 46. The dam wall 40 is adapted to bear a laterally acting load like the dam wall 10 of Figure 1.

The dam wall 40 is constructed from elongate tubes 48 of a flexible plastic or plastic laminate material divided by dividing walls of a flexible plastic or plastic laminate material into a plurality of compartments 50 running the lengths of the tubes 48. Again, the compartments 50 form the cells of the honeycomb structure. Embedded into the base 46 are a series of anchor bolts 52. Attached to each of the anchor bolts 52 is a tie or rod 54 which runs through the lengths of the compartments 50, parallel to the axes of the compartments 50.

The compartments 50 of the tubes 48 are filled with a suitable filler material such as river bed sediment. The free ends of the rods 54 are embedded in a concrete slab 56 on top of the top tube 48.

The dam wall 40 includes further rods 58 which are located transverse to the axes of the compartments 50 and also transverse to the direction of the laterally acting load. The rods 58 are embedded in the rock faces 44 and 42.

The dam wall 40 has great strength under a laterally acting load because of the fact that the whole structure is tied between the base 46 of the dam wall 40 and a rigid slab 56 on top of the dam wall 40. This prevents the dam wall 40 from being pushed over by the laterally acting load, i.e. the weight of the water.

As an alternative, the rods may only run the length of the compartments 50 of the lowest tube 48. The free ends of the rods 54 are then embedded in a concrete slab on top of the lowest tube 48. The second lowest tube 48 is then located on the slab. It may be tied to the slab or not as is required.

As a further alternative, some of the compartments 50 may be filled with a settable material such as cement so that a rigid join is formed between a rod 54 and a rod 58. The rods 54 and the rods 58 may also be connected to each other in other suitable ways.

The rods serve the dual function of the fixed structure once it is constructed and of supporting the elongate tube in position before it is filled with the filler material.

In addition, rigid support elements such as metal or wooden props may be located in some compartments prior to being filled with the filler material, to support the tube during construction of the fixed structure.

Further, the fixed structure of the invention may form simply the cave of a dam wall. In other words, the fixed structure may be covered on one or both sides by stones, bricks or the like.

The fixed structure constructed according to

the method of the invention has several advantages. Firstly, it is easy and cheap to manufacture. Secondly, the fixed structure is able to bear high laterally acting loads. Thirdly, when the fixed structure comprises a dam wall, it is more robust than a conventional earth dam wall. The dam wall resulting from the method of the invention will not readily breach when water flows over the top thereof, and will not readily "pipe", i.e. permit the formation of a hole therethrough, unlike conventional dam walls.

Claims

1. A method of forming a fixed structure (10, 30, 40) adapted to bear a laterally acting load on a support (46) from an elongate tube (16, 34, 48) of a flexible plastic or plastic laminate material divided by dividing walls of a flexible plastic or plastic laminate material into a plurality of compartments (18, 36, 50) running the length of the tube (16, 34, 48) so that the elongate tube (16, 34, 48) divided by dividing walls has a honeycomb structure, comprises the steps of:
 - (a) locating the tube (16, 34, 48) in position on the support (46) with one end of the tube (16, 34, 48) above the other end of the tube (16, 34, 48) and with the compartments (18, 36, 50) running in a direction transverse to the direction of the load;
 - (b) passing rods (20, 38, 54, 58) or the like through the elongate tube (16, 34, 48) in a direction transverse to the axes of the compartments (18, 36, 50) and/or in a direction parallel to the axes of the compartments (18, 36, 50), the rods (20, 38, 54, 58) or the like being spaced from one another;
 - (c) fixing the rods (20, 38, 54, 58) in position; and
 - (d) filling some or all of the compartments (18, 36, 50) with a suitable filler material so that at least some of the compartments (18, 36, 50) are adjacent two or more other compartments (18, 36, 50) filled with the filler material to support and be supported by the adjacent compartments (18, 36, 50).
2. A method according to Claim 1, wherein in step (b) the rods (20, 38) are passed through the tube (16, 34) in a direction transverse to the axes of the compartments (18, 36) and not transverse to the direction of the laterally acting load.
3. A method according to Claim 1 wherein in step (b), the rods (58) are passed through the tube

- (48) in a direction transverse to the axes of the compartments (50) and transverse to the direction of the laterally acting load.
4. A method according to Claim 1 wherein in step (b) some of the rods (20, 38, 58) are passed through the tube (16, 34, 48) in a direction transverse to the axes of the compartments (18, 36, 50) and not transverse to the direction of the laterally acting load and the remainder of the rods are passed in a direction transverse to the axes of the compartments and transverse to the direction of the laterally acting load.
 5. A method according to any one of Claims 1 to 4 wherein in step (b) the rods (54) are located in a direction parallel to the axes of the compartments (48).
 6. A method according to any of Claims 1 to 5 wherein the filler material comprises sand, cement, crushed stone, a particulate-containing slurry, mine tailings, fly ash, river bed sediment or bentonite or a mixture of two or more thereof.
 7. A method of forming a fixed structure (40) adapted to bear a laterally acting load on a support (46) from an elongate tube (48) of a flexible plastic or plastic laminate material divided by dividing walls of a flexible plastic or plastic laminate material into a plurality of compartments (50) running the length of the tube (48) so that the elongate tube (48) divided by dividing walls has a honeycomb structure, comprises the steps of:
 - (a) fixing a plurality of anchor means (52) into the support (46);
 - (b) locating the tube (48) in position on the support (46) with one end of the tube (48) above the other end of the tube (48) and with the compartments (50) running in a direction transverse to the direction of the load;
 - (c) locating rods (54) or the like in some or all of the compartments (50) with one end of each rod (54) or the like being attached to an anchor means (52) and with the other end of each rod (54) or the like protruding from the top of the compartments (50);
 - (d) passing rods (58) or the like through the elongate tube (48) in a direction transverse to the axes of the compartments (50), the rods (58) or the like being spaced from one another and fixing the rods (58) or the like in position;
 - (e) filling some or all of the compartments (50) with a suitable filler material so that at least some of the compartments (50) are adjacent two or more other compartments (50) filled with the filler material to support and be supported by the adjacent compartments (50); and
 - (f) placing a rigid member (56) on top of the tube (48) with the free ends of the rods (54) or the like which are located in the compartments (50) fixed into or passing through the rigid member (56).
 8. A method according to claim 7 wherein in step (d) the rods are passed through the tube in a direction transverse to the axes of the compartments and not transverse to the direction of the laterally acting load.
 9. A method according to claim 7 wherein in step (d), the rods (58) are passed through the tube (48) in a direction transverse to the axes of the compartments (50) and transverse to the direction of the laterally acting load.
 10. A method according to claim 7 wherein in step (d), the rods are passed through the tube in a direction transverse to the axes of the compartments and not transverse to the direction of the laterally acting load and in a direction transverse to the axes of the compartments and transverse to the direction of the laterally acting load.
 11. A method according to any one of claims 7 to 10 wherein the filler material comprises sand, cement, crushed stone, a particulate-containing slurry, mine tailings, fly ash river bed sediment or bentonite or a mixture of two or more thereof.

Revendications

1. Procédé pour la réalisation d'une structure fixe (10, 30, 40) adaptée pour supporter une charge agissant latéralement sur un support (46) à partir d'un tube allongé (16, 34, 48) en matière plastique ou en matière plastique laminée souple divisé par des parois de séparation en matière plastique ou en matière plastique laminée souple en une pluralité de compartiments (18, 36, 50) s'étendant sur toute la longueur du tube (16, 34, 48) de manière que le tube allongé (16, 34, 48) divisé par les parois de séparation ait une structure alvéolaire, ce procédé comprenant les étapes de:
 - (a) placer le tube (16, 34, 48) en position sur le support (48), une extrémité du tube

- (16, 34, 48) au dessus de l'autre extrémité du tube (16, 34, 48) et les compartiments (18, 36, 50) s'étendant dans une direction transversale par rapport à la direction de la charge;
- (b) faire passer des tiges (20, 38, 54, 58) ou similaires à travers le tube allongé (16, 34, 48) soit toutes dans une direction transversale par rapport aux axes des compartiments (18, 36, 50) soit toutes dans une direction parallèle aux axes des compartiments (18, 36, 50) soit certaines dans une direction transversale par rapport aux axes des compartiments (18, 36, 50) et le reste dans une direction parallèle aux axes des compartiments (18, 36, 50), les tiges (20, 38, 54, 58) ou similaires étant espacées les unes des autres ;
- (c) fixer les tiges (20, 38, 54, 58) en position ; et
- (d) remplir certains ou tous les compartiments (18, 36, 50) avec une matière de remplissage appropriée de manière qu'au moins certains des compartiments (18, 36, 50) soient adjacents à deux autres compartiments ou plus (18, 36, 50) remplis de matière de remplissage pour supporter et être supportés par les compartiments adjacents (18, 36, 50).
2. Procédé selon la revendication 1, dans lequel à l'étape (b) on fait passer les tiges (20, 38) à travers le tube (16, 34) dans une direction transversale par rapport aux axes des compartiments (18, 36) et non pas transversale par rapport à la direction de la charge agissant latéralement.
 3. Procédé selon la revendication 1, dans lequel à l'étape (b), on fait passer les tiges (58) à travers le tube (48) dans une direction transversale par rapport aux axes des compartiments (50) et transversale par rapport à la direction de la charge agissant latéralement.
 4. Procédé selon la revendication 1, dans lequel à l'étape (b) on fait passer certaines des tiges (20, 38, 58) à travers le tube (16, 34, 48) dans une direction transversale par rapport aux axes des compartiments (18, 36, 50) et non pas transversale par rapport à la direction de la charge agissant latéralement et on fait passer le reste des tiges dans une direction transversale par rapport aux axes des compartiments et transversale par rapport à la direction de la charge agissant latéralement.
 5. Procédé selon l'une quelconque des revendications 1 à 4, dans lequel à l'étape (b) les tiges (54) sont situées dans une direction parallèle aux axes des compartiments (48).
 6. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel la matière de remplissage comprend du sable, du ciment, de pierre concassée, une boue contenant des particules, des schlamms, de la cendre volante, des sédiments fluviaux ou de la bentonite ou un mélange de deux ou plus de ces matériaux.
 7. Procédé pour la réalisation d'une structure fixe (40) adaptée pour supporter une charge agissant latéralement sur un support (46) à partir d'un tube allongé (48) en matière plastique ou en matière plastique laminée souple divisé par des parois de séparation en matière plastique ou en matière plastique laminée souple en une pluralité de compartiments (50) s'étendant sur toute la longueur du tube (48) de manière que le tube allongé (48) divisé par les parois de séparation ait une structure alvéolaire, ce procédé comprenant les étapes de:
 - (a) fixer une pluralité de moyens d'ancrage (52) dans le support (46) ;
 - (b) placer le tube (48) en position sur le support (46), une extrémité du tube (48) au dessus de l'autre extrémité du tube (48) et les compartiments (50) s'étendant dans une direction transversale par rapport à la direction de la charge ;
 - (c) placer les tiges (54) ou similaires dans certains ou tous les compartiments (50), une extrémité de chaque tige (54) ou similaire étant attachée aux moyens d'ancrage (52) et l'autre extrémité de chaque tige (54) ou similaire faisant saillie à partir du dessus des compartiments (50) ;
 - (d) faire passer les tiges (58) ou similaires à travers le tube allongé (48) dans une direction transversale par rapport aux axes des compartiments (50), les tiges (58) ou similaires étant espacées les unes des autres et fixer les tiges (58) ou similaires en position ;
 - (e) remplir certains ou tous les compartiments (50) avec une matière de remplissage appropriée de manière qu'au moins certains des compartiments (50) soient adjacents à deux autres compartiments (50) ou plus, remplis de matière de remplissage pour supporter et être supportés par les compartiments adjacents (50) ; et
 - (f) placer un membre rigide (56) au-dessus du tube (48), les extrémités dégagées des tiges (54) ou similaires qui sont situées dans les compartiments (50) étant fixées dans ou traversant le membre rigide (56).

8. Procédé selon la revendication 7, dans lequel à l'étape (d) on fait passer les tiges à travers le tube dans une direction transversale par rapport aux axes des compartiments et non pas transversale par rapport à la direction de la charge agissant latéralement. 5
9. Procédé selon la revendication 7, dans lequel à l'étape (d), on fait passer les tiges (58) à travers le tube (48) dans une direction transversale par rapport aux axes des compartiments (50) et transversale par rapport à la direction de la charge agissant latéralement. 10
10. Procédé selon la revendication 7, dans lequel à l'étape (d), on fait passer les tiges à travers le tube dans une direction transversale par rapport aux axes des compartiments et non pas transversale par rapport à la direction de la charge agissant latéralement et dans une direction transversale par rapport aux axes des compartiments et transversale par rapport à la direction de la charge agissant latéralement. 15 20
11. Procédé selon l'une quelconque des revendications 7 à 10, dans lequel la matière de remplissage comprend du sable, du ciment, de la pierre concassée, une boue contenant des particules, des schlamms, de la cendre volante, des sédiments fluviaux ou de la bentonite ou un mélange de deux ou plus de ces matériaux. 25 30
- Ansprüche** 35
1. verfahren zum Bilden einer ortsfesten Konstruktion (10, 30, 40), die eine seitlich wirkende Belastung aushalten kann, auf einer Unterlage (46) aus einer aus einem elastischen Kunststoff- oder kunststoffbeschichteten Material bestehenden Langröhre (16, 34, 48), die durch Trennwände aus einem elastischen Kunststoff- oder kunststoffbeschichteten Material in eine Vielzahl von die Länge der Röhre (16, 34, 48) entlang verlaufenden Unterteilungen (18, 36, 50) so aufgeteilt ist, daß die durch Trennwände aufgeteilte Langröhre (16, 34, 48) eine wabenstruktur aufweist, wobei das Verfahren folgende Schritte umfaßt: 40 45
- (a) Positionieren der Röhre (16, 34, 48) auf der Unterlage (48), wobei sich ein Ende der Röhre (16, 34, 48) über dem anderen Ende der Röhre (16, 34, 48) befindet und die Unterteilungen (18, 36, 50) in einer zu der Richtung der Belastung quer verlaufenden Richtung verlaufen; 50
- (b) Hindurchführen von Stangen (20, 38, 54, 58) oder dergleichen durch die Langröhre (16, 34, 48), und zwar entweder alle in einer zu den Achsen der Unterteilungen (18, 36, 50) quer verlaufenden Richtung oder alle in einer zu den Achsen der Unterteilungen (18, 36, 50) parallel verlaufenden Richtung, oder einige in einer zu den Achsen der Unterteilungen (18, 36, 50) quer und der Rest in einer zu den Achsen der Unterteilungen (18, 36, 50) parallel verlaufenden Richtung, wobei die Stangen (20, 38, 54, 58) oder dergleichen voneinander beabstandet sind; (c) Festmachen der Stangen (20, 38, 54, 58); und (d) Füllen von einigen oder allen Unterteilungen (18, 36, 50) mit einem geeigneten Füllmaterial, so daß wenigstens einige der Unterteilungen (18, 36, 50) sich angrenzend an zwei oder mehrere andere, mit dem Füllmaterial gefüllte Unterteilungen (18, 36, 50) befinden, um die angrenzenden Unterteilungen (18, 36, 50) zu stützen und davon gestützt zu werden. 55
2. Verfahren nach Anspruch 1, wobei im Schritt (b) die Stangen (20, 38) in einer zu den Achsen der Unterteilungen (18, 36) quer verlaufenden Richtung, und nicht quer zu der Richtung der seitlich wirkenden Belastung, durch die Röhre (16, 34) hindurchgeführt werden.
3. Verfahren nach Anspruch 1, wobei im Schritt (b) die Stangen (58) in einer zu den Achsen der Unterteilungen (50) und zu der Richtung der seitlich wirkenden Belastung quer verlaufenden Richtung durch die Röhre (48) hindurchgeführt werden.
4. Verfahren nach Anspruch 1, wobei im Schritt (b) einige der Stangen (20, 38, 58) in einer zu den Achsen der Unterteilungen (18, 36, 50) quer verlaufenden Richtung, und nicht quer zu der Richtung der seitlich wirkenden Belastung, durch die Röhre (16, 34, 48) hindurchgeführt werden, und der Rest der Stangen in einer zu den Achsen der Unterteilungen und zu der Richtung der seitlich wirkenden Belastung quer verlaufenden Richtung hindurchgeführt werden.
5. Verfahren nach einem der Ansprüche 1 bis 4, wobei sich im Schritt (b) die Stangen (54) in einer zu den Achsen der Unterteilungen (48) parallel verlaufenden Richtung befinden.
6. Verfahren nach einem der Ansprüche 1 bis 5, wobei das Füllmaterial Sand, Zement, Schotter, Partikel enthaltenden Schlamm, Haldenabfall, Flugasche, Flußbettsediment oder Bentonit

bzw. eine Mischung von zwei oder mehreren dieser Materialien umfaßt.

7. Verfahren zum Bilden einer ortsfesten Konstruktion (40), die eine seitlich wirkende Belastung aushalten kann, auf einer Unterlage (46) aus einer aus einem elastischen Kunststoff- oder kunststoffbeschichteten Material bestehenden Langröhre (48), die durch Trennwände aus einem elastischen Kunststoff- oder kunststoffbeschichteten Material in eine Vielzahl von die Länge der Röhre (48) entlang verlaufenden Unterteilungen (50) so aufgeteilt ist, daß die durch Trennwände aufgeteilte Langröhre (48) eine Wabenstruktur aufweist, wobei das Verfahren folgende Schritte umfaßt:
 - (a) Befestigen einer Vielzahl von Ankereinrichtungen (52) in der Unterlage (46);
 - (b) Positionieren der Röhre (48) auf der Unterlage (46), wobei sich ein Ende der Röhre (48) über dem anderen Ende der Röhre (48) befindet und die Unterteilungen (50) in einer zu der Richtung der Belastung quer verlaufenden Richtung verlaufen;
 - (c) Positionieren von Stangen (54) oder dergleichen in einigen oder allen Unterteilungen (50), wobei ein Ende jeder Stange (54) oder dergleichen an einer Ankereinrichtung (52) befestigt ist und das andere Ende jeder Stange (54) oder dergleichen am oberen Ende der Unterteilungen (50) hervorsteht;
 - (d) Hindurchführen von Stangen (58) oder dergleichen durch die Langröhre (48) in einer zu den Achsen der Unterteilungen (50) quer verlaufenden Richtung, wobei die Stangen (58) oder dergleichen voneinander beabstandet sind, und Festmachen der Stangen (58) oder dergleichen;
 - (e) Füllen von einigen oder allen Unterteilungen (50) mit einem geeigneten Füllmaterial, so daß wenigstens einige der Unterteilungen (50) sich angrenzend an zwei oder mehrere andere, mit dem Füllmaterial gefüllte Unterteilungen (50) befinden, um die angrenzenden Unterteilungen (50) zu stützen und davon gestützt zu werden; und
 - (f) Anbringen eines starren Elements (56) oben auf der Röhre (48), wobei die freien Enden der sich in den Unterteilungen (50) befindenden Stangen (54) oder dergleichen in dem starren Element (56) befestigt sind oder hindurchverlaufen.
8. Verfahren nach Anspruch 7, wobei im Schritt (d) die Stangen in einer zu den Achsen der Unterteilungen quer verlaufenden Richtung, und nicht quer zu der Richtung der seitlich wirkenden Belastung, durch die Röhre hin-

durchgeführt werden.

9. Verfahren nach Anspruch 7, wobei im Schritt (d) die Stangen (58) in einer zu den Achsen der Unterteilungen (50) und zu der Richtung der seitlich wirkenden Belastung quer verlaufenden Richtung durch die Röhre (48) hindurchgeführt werden.
10. Verfahren nach Anspruch 7, wobei im Schritt (d) die Stangen in einer zu den Achsen der Unterteilungen quer verlaufenden Richtung, und nicht quer zu der Richtung der seitlich wirkenden Belastung, und in einer zu den Achsen der Unterteilungen und zu der Richtung der seitlich wirkenden Belastung quer verlaufenden Richtung durch die Röhre hindurchgeführt werden.
11. Verfahren nach einem der Ansprüche 7 bis 10, wobei das Füllmaterial Sand, Zement, Schotter, Partikel enthaltenden Schlamm, Haldenabfall, Flugasche, Flußbettsediment oder Bentonit bzw. eine Mischung von zwei oder mehreren dieser Materialien umfaßt.

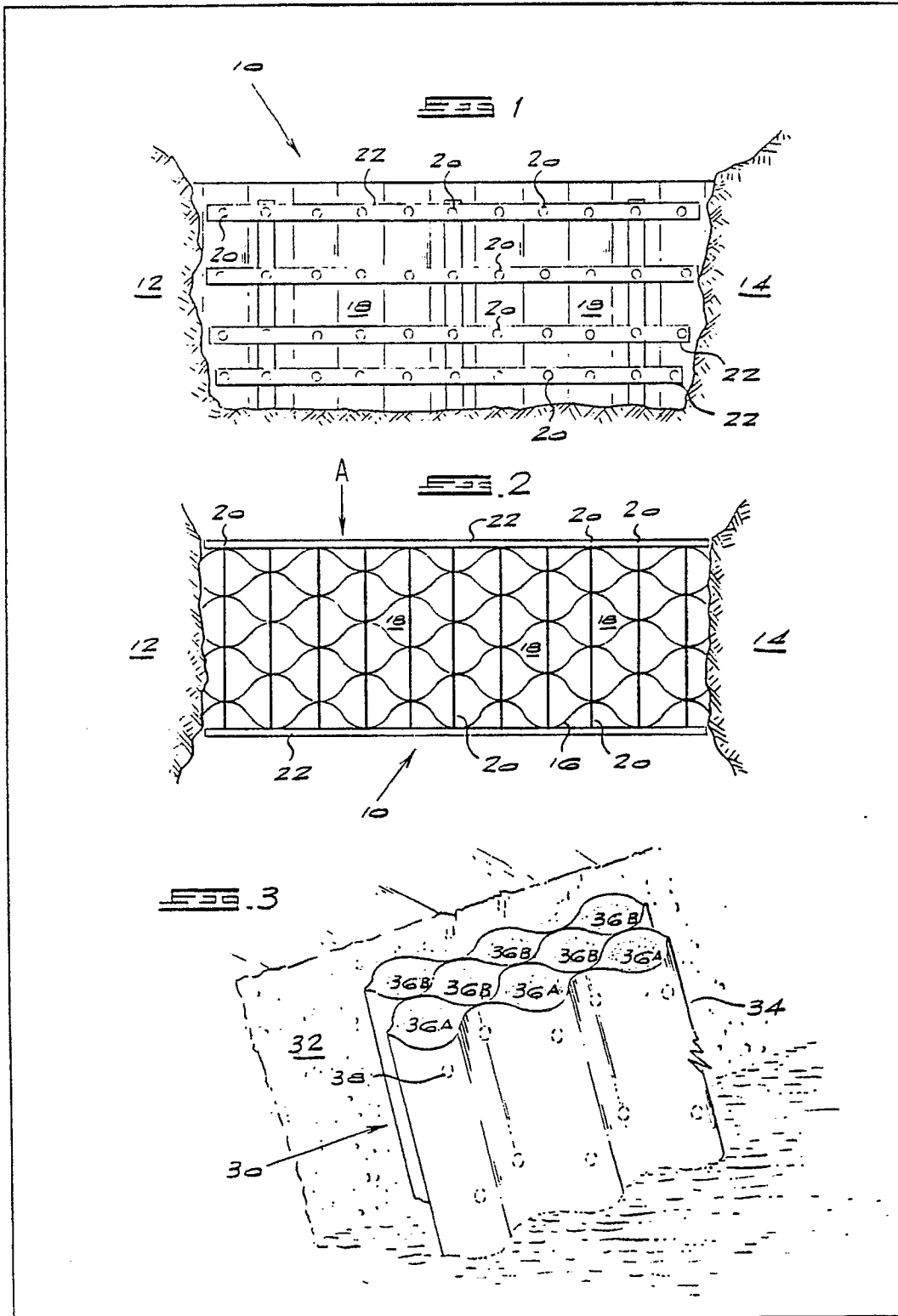


Fig. 4

