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(54) **A stormwater attenuation tank and a method of manufacturing same**

(57) The present invention is concerned with a stormwater attenuation tank (10), and a method for manufacturing same, which tank is formed from a plurality of precast wall (16) and roof (22) units, such that the tank is modular in form. The precast wall units (16)

are seated, in use, on pre-prepared and levelled foundation pads (28) which thus allow the wall units to be quickly and easily dropped into position on same, without further reference to the level, plumb, and orientation of the wall units (16).

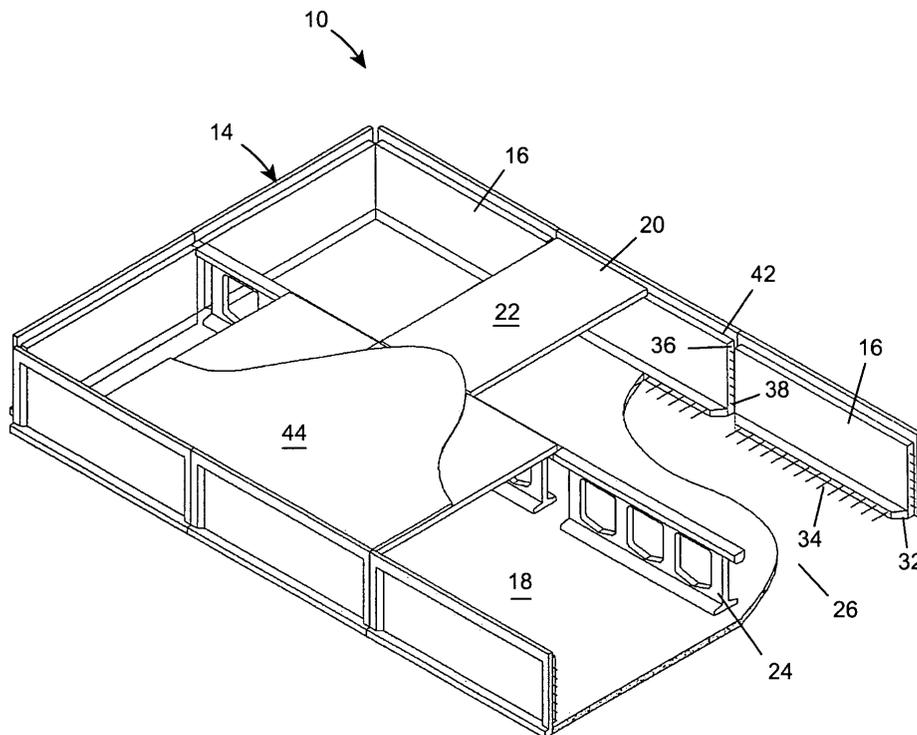


Fig. 1

Description

[0001] The present invention is concerned with a stormwater attenuation tank, and a method for manufacturing same, the tank being designed for use as a buffering device to collect excess stormwater within a residential or industrial development for slow release to a municipal sewer or the like. Used in combination with a flow control device or the like, the loading on the municipal sewer is controlled, thereby reducing the possibility of flooding in vulnerable areas during periods of exceptional rainfall.

[0002] The conventional approach to stormwater attenuation has been to construct an assembly of culverts or large diameter concrete pipes. In principle this allows the volume of the sewerage system to contain the excess stormwater. Both these methods are however inefficient, due to their high surface area to volume ratios, and because of other limitations including maintaining the water proofing capability of culverts. Both approaches generate a substantial perimeter joint, around the abutting ends of adjacent sections of pipe, which therefore has relatively high maintenance requirements. The volume requirements for attenuation tanks are also increasing, making the above methods further unsuitable.

[0003] Soak-away chambers are suitable in areas where flash flooding occurs, but where there is scope for in-ground drainage after the flooding. Multiple tank assemblies are suitable where the attenuation volumes are relatively small, up to approximately 200 cubic meters, or where there is a desire to attenuate on a unit by unit basis in an industrial or residential development. Cast in situ concrete tanks are also possible, but are rarely used, as the construction time is substantially longer and more expensive than the above systems.

[0004] It is therefore an object of the present invention to provide a stormwater attenuation system which overcomes the problems of the prior art systems.

[0005] It is a further object of the present invention to provide a method of manufacturing a stormwater attenuation tank, which method substantially reduces the manufacturing time, and therefore expense, while maintaining a high level of quality in the finished product.

[0006] The present invention therefore provides, in its first aspect, a stormwater attenuation tank comprising an inlet through which to channel stormwater; an outlet adapted for fluid communication with a sewerage system; a floor; a modular perimeter wall; and a roof.

[0007] Preferably, the perimeter wall is comprised of a plurality of preformed wall units.

[0008] Preferably, the tank comprises at least one internal wall.

[0009] Preferably, the at least one internal wall stands on the floor.

[0010] Preferably, each wall unit is mounted, in use, on at least one foundation pad in order to ensure the accurate placement of each wall unit.

[0011] Preferably, at least one locating member

projects from each foundation pad for operative engagement with a corresponding recess in the respective wall unit.

[0012] Preferably, the floor of the tank is cast in place.

5 **[0013]** Preferably, each wall unit includes one or more reinforcing members projecting from a base of the wall unit, which reinforcing members are embedded, in use, in the floor.

10 **[0014]** Preferably, adjacent wall units are sealed by means of a hydrophilic barrier.

[0015] Preferably, an end of each wall unit is recessed such that adjacent wall units define a cavity for receiving the hydrophilic barrier.

15 **[0016]** Preferably, each cavity is filled, in use, with concrete such as to secure the respective hydrophilic barrier in place.

[0017] Preferably, the roof is formed from preformed roof units.

20 **[0018]** Preferably, the roof is covered with a layer of concrete which seals both adjacent roof units, and adjacent roof units and wall units.

[0019] Preferably, the floor has a fall of between 1:100 and 1:600 along the length thereof.

25 **[0020]** According to a second aspect of the present invention there is provided a method of manufacturing an attenuation tank according to the first aspect, the method comprising the steps of locating a plurality of preformed wall units in end to end alignment on a bed to form a perimeter wall; pouring a concrete floor onto the bed within the perimeter wall; and mounting a roof across the perimeter wall to substantially seal the tank.

30 **[0021]** Preferably, the method comprises the further steps of forming a plurality of foundation pads on the bed; and seating the wall units onto the foundation pads in order to ensure the accurate placement of each wall unit.

35 **[0022]** Preferably, the method comprises the further step of providing at least one locating member on each foundation pad, for operative engagement with a corresponding recess in each wall unit.

40 **[0023]** Preferably, the method comprises providing reinforcing members projecting from a base of each wall unit, which reinforcing members are embedded in the floor of the tank when poured.

45 **[0024]** Preferably, the method comprises the step of sealing adjacent wall units by means of a hydrophilic barrier.

[0025] Preferably, the method comprises providing at least one internal wall to give additional support to the roof.

50 **[0026]** Preferably, the method comprises standing the at least one internal wall on the floor.

[0027] As used herein, the term "preformed" is intended to mean an object or component has been manufactured, in particular off site, prior to the inclusion thereof as an integral component of some larger system, and is particularly intended to refer to the process of precasting concrete components off site, such components having

substantially or fully cured prior to inclusion in a tank according to the present invention.

[0028] As used herein, the term "stand" is intended to mean the act of having one component located or positioned on top of another component or surface, without there being any physical join or interengagement being required or formed between the two components, such that continuity of the abutting surfaces of the two components is preserved.

[0029] As used herein, the term "foundation pad" is intended to mean a support or abutment which is fixed in place, and onto which one or more components may be located in such a manner that the location and orientation of said components is guaranteed within certain acceptable tolerances.

[0030] As used herein, the term "locating member" is intended to mean an element which co-operates with another component or portion thereof, in order to guide and fix the location of said component.

[0031] The present invention will now be described with reference to the accompanying drawings, in which;

Figure 1 illustrates a perspective view of an attenuation tank according to the present invention;

Figure 2 illustrates a sectioned side elevation of the attenuation tank of Figure 1, located in situ;

Figure 3 illustrates a perspective view of a wall unit forming part of the tank of Figure 1; and

Figure 4 illustrates a perspective view of a foundation pad onto an array of which a plurality of the wall units of Figure 3 are seated in order to form a perimeter wall of the tank of Figure 1.

[0032] Referring now to the accompanying drawings, there is illustrated an attenuation tank, generally indicated as 10, which in use is operable to collect and store excess stormwater within a residential or industrial development, or at any other desired location, for controlled release to a municipal sewer (not shown) or the like, at a rate which avoids overloading of the municipal sewer. The tank 10 is thus connected between the conventional drainage system (not shown) of the development/location in question, and the respective municipal sewer, such that the tank 10 acts as a buffer to prevent overloading of the municipal sewer. The tank 10 is thus provided with a conventional inlet (not shown) at any suitable location in the tank 10, which in use is in fluid communication with the drainage system, and a conventional outlet (not shown), again at any suitable location in the tank 10, which in use is in fluid communication with the municipal sewer.

[0033] The tank 10 further includes some form of proprietary flow control means (not shown) such as an orifice plate (not shown) or vortex generator (not shown), preferably located between the tank 10 and the municipal

sewer, in order to control the flow of the stormwater from the tank 10 into the municipal sewer. It will be appreciated that any conventional flow control means may be used, and that the tank 10 may be connected to both the residential or industrial development, and the sewer, by conventional means (not shown), such as conventional concrete sewerage pipes (not shown) or the like. It will also be appreciated that the flow control means should be selected such as to discharge stormwater from the tank 10 at a rate which is suitable for the particular municipal sewer into which the tank 10 discharges. Thus the flow control means will have to be selected or adapted to suit each location at which the tank 10 is installed.

[0034] It will also be understood that the tank 10 may be provided with a single inlet/outlet (not shown), with the tank 10 therefore being connected in parallel to the conventional drainage system (not shown) leading to the municipal sewer. In this way, during periods of excess stormwater runoff, once the drainage system reaches maximum capacity, the excess water will feed into the tank 10, which will thus act as a buffer. Once the stormwater runoff has abated, the water within the tank 10 will then flow back through the inlet/outlet (not shown) thereof, and through the drainage system to the municipal sewer. The internal diameter of the pipework (not shown) leading from the inlet/outlet will therefore act as the flow control means (not shown) mentioned above.

[0035] Due to the volume of the tank 10, the conventional practice will be to locate the tank 10 within a subterranean excavation (not shown), which will also facilitate gravitational drainage into the tank 10, thereby avoiding the need for pumps (not shown) or the like. The tank 10 is not however limited to use in such subterranean excavations, and could be located above ground, or partially submerged, depending on the conditions prevailing at the site (not shown) where the tank 10 is to be installed.

[0036] The tank 10 comprises a modular perimeter wall 14, consisting of a plurality of wall units 16 in end to end alignment, and a floor 18 extending between the perimeter wall 14. In addition the tank 10 comprises a roof 20 which consists of an array of roof units 22 in side by side engagement. In the embodiment illustrated, where the tank 10 is two wall units 16 wide, a line of internal walls 24 is also provided, in order to support the roof units 22. The wall units 16, roof units 22, and internal walls 24 are all precast offsite, to exact tolerances, thereby dramatically reducing the length of time taken to manufacture the tank 10 on site. Conventionally, stormwater runoff tanks (not shown), when manufactured from concrete, would be cast as a monolithic structure on site. This process requires the extremely accurate preparation of the foundation or bed (not shown) onto which the runoff tank (not shown) is to be cast. Following the preparation of the bed all of the shuttering (not shown) then has to be erected on the bed, into which wet concrete is poured to form the runoff tank.

Again the position and orientation of the shuttering must be accurately set out, as any error would require the demolition and rebuilding of the runoff tank. The use of the precast wall units 16 avoids the above mentioned problems.

[0037] However, the use of precast components requires the accurate alignment of adjacent wall units 16, both to facilitate the production of a seal therebetween, as will be described in detail hereinafter, in addition to the accurate and secure placement of the roof units 22 onto the wall units 16. This requirement therefore increases the length of time required to prepare the site before the wall units 16 may be located. This is particularly true where a bed 26, on which the tank 10 is to be located, has not been laid level, or is not to a high enough standard, for alignment of the wall units 16. This problem is compounded by the fact that the tank 10 should have a fall of between 1 in 100 and 1 in 600, preferably 1 in 300, along the length thereof, in order to effect the gravitational feed of stormwater therefrom, and thus the bed 26 should have an equivalent fall therealong.

[0038] The present invention therefore employs a unique system to reduce the manufacturing time of the tank 10, while ensuring the accurate positioning and relative alignment of the various components thereof. Thus, prior to locating the wall units 16, an array of foundation pads 28 are set into the bed 26, one of which is illustrated in Figure 4, to follow the proposed line of the perimeter wall 14. The foundation pads 28 then serve as supports or feet onto which the wall units 16 are seated, ensuring the correct location and alignment of the wall units 16, which will not require any further alignment once seated in place.

[0039] In order to ensure that all of the foundation pads 28 are accurately positioned with respect to one another, and the bed 26, it is preferable to use a conventional laser level (not shown) to set out the height at which the plurality of foundation pads 28 should be located. For maximum usability, the laser level should be set as close as possible to the centre of the site on which the tank 10 is to be built. Once set up, preferably on a tripod (not shown) or the like, the laser level should not be moved, both to save time and to avoid potential error. Once secured, the laser level is switched on, following which it will effect self levelling over a couple of seconds. The rotate button is then pressed to rotate the head of the laser level, which thus results in a level plane being identifiable all around the site. The conventional arrangement of a laser detector (not shown) mounted on a shaft is then set to indicate the required excavation depth at which to provide the foundation pads 28, which are preferably 150mm deep, below the underside level of the wall units 16.

[0040] If the tank 10 is to include a fall along the length thereof, the laser level (not shown) must be set up to incorporate the correct drop over the length of the tank 10. This is achieved by tilting the axis of the laser level

about which the head rotates, such that the plane indicated by the laser level is suitably tilted with respect to the horizontal. The angle at which the head is tilted can be varied in order to give different degrees of fall, in order to suit the particular requirements of the tank 10.

[0041] A mini digger (not shown) or the like is initially used to create a small excavation in the bed 26, at the plurality of pre-determined locations. One of the foundation pads 28 is then constructed in each excavation, to the level of the proposed underside of the perimeter wall 14, as indicated by the laser level, or alternatively by any other suitable means. A steel mould (not shown) or the like is preferably used to ensure the accurate construction of each foundation pad 28. The upper surface of each foundation pad 28 is checked using a conventional spirit level (not shown) or the like. Accurate positioning of the foundation pads 28 is essential, although it will be appreciated that this work takes far less time than trying to level each wall unit 16, once seated on the bed 26, particularly in view of the substantial weight and size of each wall unit 16.

[0042] It is preferable that each wall unit 16 is seated on a pair of the foundation pads 28, one preferably being located at or adjacent either end of the respective wall unit 16. It will be understood that more or less than a pair of the foundation pads 28 could be provided under each wall unit 16, although the use of a single foundation pad 28 would be unlikely to give sufficient support to each wall unit 16.

[0043] Once each foundation pad 28 has been poured, and while the concrete is still wet, a pair of locating members in the form of locating pins 30 are inserted, vertically, into the foundation pad 28, which locating pins 30 will coincide with corresponding receiving members in the form of recesses (not shown) on the underside of each wall unit 16, allowing the wall units 16 to be positioned accurately and in any order, without further reference to measurement. A template (not shown) is preferably used to mark-out the position of the locating pins 30 on each foundation pad 28. The foundation pads 28, with the locating pins 30 therein, are preferably allowed to set overnight, in order to ensure that the locating pins 30 will not be knocked out of alignment during positioning of the wall units 16. It will also be appreciated that locating pins (not shown) could be fixed to the underside of the wall units 16, with corresponding recesses (not shown) being provided in the foundation pads 28. This arrangement is however far less practical, as the locating pins (not shown) would prevent the wall units 16 from being stored in an upright position, as the locating pins (not shown) would likely be damaged or bent out of position due to the weight of the wall unit 16 bearing down on same. It will also be understood that any other suitable arrangement could be used in place of the locating pins 30 and corresponding recesses (not shown) in order to enable the wall units 16 to be quickly and accurately positioned and retained on the foundation pads 28.

[0044] Once all of the foundation pads 28 are set, the plurality of wall units 16 are dropped into place onto the foundation pads 28, with the locating pins 30 ensuring the exact positioning of each wall unit 16. Prior to dropping each wall unit 16 into place on the respective foundation pad 28, the top face of the foundation pad 28 should be cleared of any debris such as stones or the like, as any such debris could affect the final plumb and level of the wall unit 16. In addition, the surface of the bed 26 between each of the foundation pads 28 is filled and brought to level either by scraping away excess material or by filling using any suitable material, for example stone or sand. The floor 18 is preferably 200mm thick, and thus conventional steel fibre reinforcement is normally adequate for reinforcing the floor 18. For extreme burial or external groundwater pressures, the strength of the floor 18 is preferably supplemented with conventional steel mesh reinforcing elements (not shown) or the like, placed on the bed 26, around which the floor will be poured in order to encase same, thus considerably increasing the strength of the floor 18.

[0045] Thus the floor 18 is poured and levelled, ensuring that the required fall along the length thereof is incorporated, if the tank 10 is to be provided with such a fall. In order to effect a bond between the floor 18 and the perimeter wall 14, such as to create a water tight seal therebetween, each wall unit 16 has a foot 32 from which projects, substantially horizontally, a plurality of reinforcing members 34. The reinforcing members 34 are cast into the wall units 16 during production. The floor 18 is then poured level with the feet 32, thereby surrounding the reinforcing members 34, which therefore form a solid connection between the perimeter wall 14 and the floor 18.

[0046] When the floor 18 has set, a line of the internal walls 24 are then positioned within the tank 10, seated directly onto the floor 18. The internal walls 24 do not require fixing in position, as the self weight and overburden of the internal walls 24 would require a substantial disturbing force which cannot exist in normal service of the tank 10. Positioning the internal walls 24 onto the floor 18, as opposed to casting same within the floor 18 as with the wall units 16, eliminates the need to form a seal between the floor 18 and the internal walls 24, again reducing the time taken to manufacture the tank 10. The consequent reduction in the height of the internal walls 24 also reduces the weight thereof, allowing easier handling of same. Seating the internal walls 24 directly on the floor 18 also provides structural continuity to the floor 18 beneath each internal wall 24, thus expanding the dimensional limitations of the tank 10. The internal walls 24 additionally provide a simple yet effective restraint to upward bending of the floor 18, in particular during periods when the tank 10 is empty and there is a high level of external groundwater. The enlarged base or foot of each internal wall 24 reduces the effective span of the floor 18.

[0047] It will be understood that if the tank 10 were

narrower, for example only a single wall unit 16 in width, the internal walls 24 could be omitted. Conversely, if the tank 10 were wider, for example three or four wall units 16 in width, additional lines of internal walls 24 would preferably be included. This enables the roof units 22 to be fixed in size, regardless of the width of the tank 10, again reducing the time taken to manufacture the tank 10.

[0048] Once the internal walls 24 are in place, and before the roof units 22 are dropped into position, adjacent wall units 16 are sealed together. Thus, referring to Figure 3, each wall unit 16 is provided with a recess 36, projecting into which, from the wall unit 16, is a reinforcing web 38, which is cast into the wall unit 16 during manufacture. In order to seal adjacent pairs of the wall units 16, conventional shuttering (not shown) is seated against the respective pair of recesses 36, and concrete then poured into same, to form a seal. Although not illustrated in Figure 3, when adjacent wall units 16 are being sealed, the floor 18 will already have been poured, and thus the shuttering (not shown) need only extend to the foot 32 of each wall unit 16.

[0049] In order to ensure self-healing joints between adjacent wall units 16, a hydrophilic strip (not shown), or equivalent, is provided along the edge of each wall unit 16, within the recess 36. The reinforcing web 38 therefore serves to aid in retaining the concrete within the recess 38, allowing the hydrophilic strip to function. The hydrophilic strips (not shown) are attached to all critical interfaces during the offsite production of the wall units 16, again saving time onsite.

[0050] Once the wall units 16 are sealed, the roof units 22 may be located. In order to facilitate the accurate and speedy location of the roof units 22, each wall unit 16 is provided with a shoulder 42 at the top thereof, onto which the edge of each roof unit 22 sits. The wall units 16 each taper upwardly away from the shoulder 42, to further aid in the easy placement of the roof units 22. As detailed above, the modular nature of the tank 10, in particular the use of the internal walls 24, enables a single size of roof unit 22 to be used, regardless of the overall dimensions of the tank 10. This also allows the roof units 22 to be positioned in any order, further reducing the time taken to manufacture the tank 10.

[0051] When all of the roof units 22 are in place, a layer of screed 44 or the like is poured over the roof 20 to seal same. The tapered profile of the top of each wall unit 16 also allows the screed 44 to seep downwardly between the edge of each roof unit 22 and the corresponding wall unit 16, thereby forming a water tight seal between the roof units 22 and the wall units 16, effectively performing two jobs at once.

[0052] At this point the tank 10 is ready to be connected to the drain system (not shown) of the business or residential development in question, and to the municipal sewer (not shown) serving the development.

[0053] It will therefore be appreciated that the present invention provides a discrete, high volume buffer to pre-

vent flooding of sewers following the drainage of storm water from business and residential developments or the like. The tank 10 can be manufactured in relatively little time and yet to very high tolerances.

Claims

1. A stormwater attenuation tank (10) comprising an inlet through which to channel stormwater; an outlet adapted for fluid communication with a sewerage system; a floor (18); a modular perimeter wall (14); and a roof (20). 5
2. A stormwater attenuation tank (10) according to claim 1 in which the perimeter wall (14) is comprised of a plurality of preformed wall units (16). 10
3. A stormwater attenuation tank (10) according to claim 1 or 2 comprising at least one internal wall (24). 15
4. A stormwater attenuation tank (10) according to claim 3 in which the at least one internal wall (24) stands on the floor (18). 20
5. A stormwater attenuation tank (10) according to any of claims 2 to 4 in which each wall unit (16) is mounted, in use, on at least one foundation pad (28) in order to ensure the accurate placement of each wall unit (16). 25
6. A stormwater attenuation tank (10) according to claim 5 in which at least one locating member (30) projects from each foundation pad (28) for operative engagement with a corresponding receiving member in the respective wall unit (16). 30
7. A stormwater attenuation tank (10) according to any preceding claim in which the floor (18) is cast in place. 35
8. A stormwater attenuation tank (10) according to any of claims 2 to 7 in which each wall unit (16) includes one or more reinforcing members (34) projecting from a base (32) of the wall unit (16), which reinforcing members (34) are embedded, in use, in the floor (18). 40
9. A stormwater attenuation tank (10) according to any of claims 2 to 8 in which adjacent wall units (16) are sealed by means of a hydrophilic barrier. 45
10. A stormwater attenuation tank (10) according to claim 9 in which an end of each wall unit (16) is provided with a recess (36) such that adjacent wall units (16) define a cavity for receiving the hydrophilic barrier. 50
11. A stormwater attenuation tank (10) according to claim 10 in which each cavity is filled, in use, with concrete such as to secure the respective hydrophilic barrier in place. 55
12. A stormwater attenuation tank (10) according to any preceding claim in which the roof (20) is formed from preformed roof units (22).
13. A stormwater attenuation tank (10) according to claim 12 in which the roof (20) is covered with a layer of concrete (44) which seals both adjacent roof units (22), and adjacent roof units (22) and wall units (16).
14. A stormwater attenuation tank (10) according to any preceding claim in which the floor (18) has a fall of between 1:100 and 1:600 along the length thereof.
15. A method of manufacturing an attenuation tank (10) according to any of claims 1 to 14, the method comprising the steps of locating a plurality of preformed wall units (16) in end to end alignment on a bed (26) to form a perimeter wall (14); pouring a concrete floor (18) onto the bed (26) within the perimeter wall (14); and mounting a roof (20) across the perimeter wall (14) to substantially seal the tank (10).
16. A method of manufacturing an attenuation tank (10) according to claim 15 comprising the further steps of forming a plurality of foundation pads (28) on the bed (26); and seating the wall units (16) onto the foundation pads (28) in order to ensure the accurate placement of each wall unit (16).
17. A method of manufacturing an attenuation tank (10) according to claim 16 comprises the further step of providing at least one locating member (30) on each foundation pad (28), for operative engagement with a corresponding recess in each wall unit (16).
18. A method of manufacturing an attenuation tank (10) according to any of claims 15 to 17 comprising providing reinforcing members (34) projecting from a base (32) of each wall unit (16), which reinforcing members (34) are embedded in the floor (18) of the tank (10) when poured.
19. A method of manufacturing an attenuation tank (10) according to any of claims 15 to 18 comprising the step of sealing adjacent wall units (16) by means of a hydrophilic barrier.
20. A method of manufacturing an attenuation tank (10) according to any of claims 15 to 19 comprising providing at least one internal wall (24) to give additional support to the roof (20).

21. A method of manufacturing an attenuation tank (10) according to claim 20 comprising standing the at least one internal wall (24) on the floor (18).

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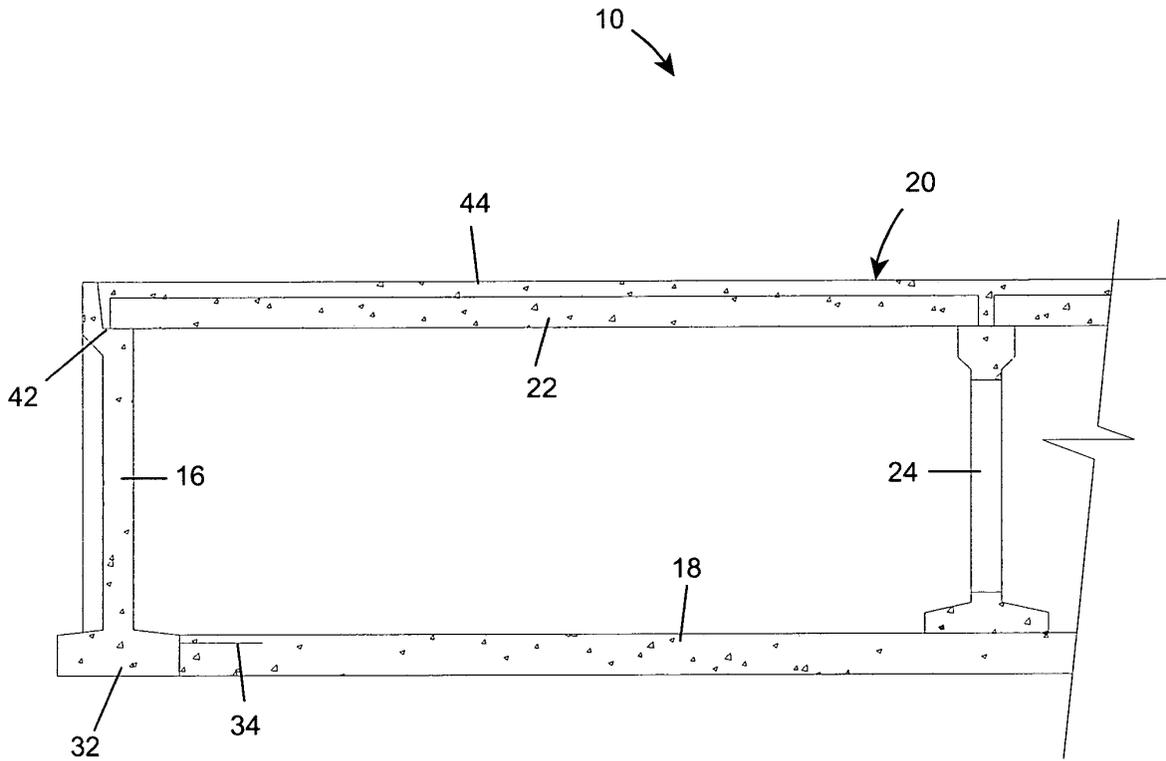


Fig. 2

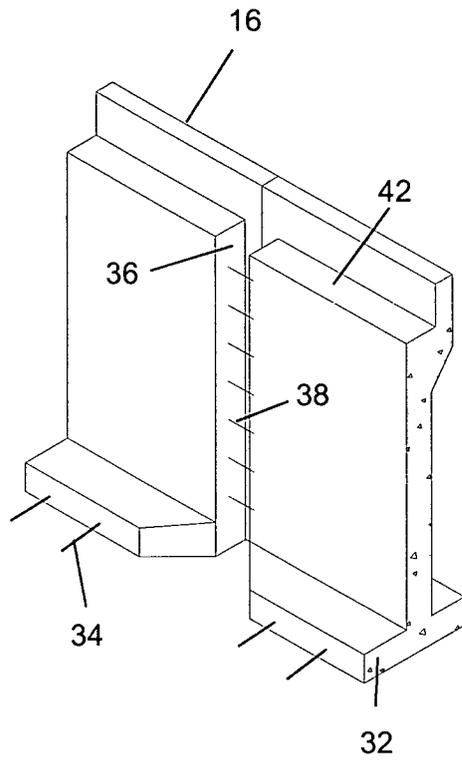


Fig. 3

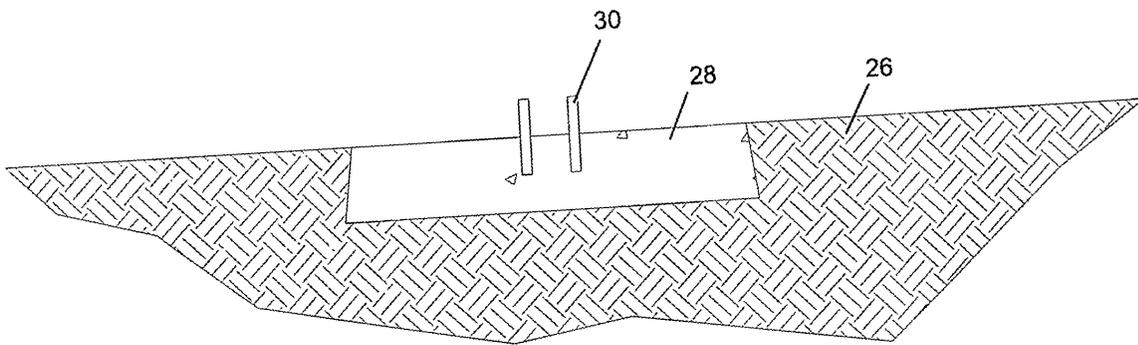


Fig. 4



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 3 429 473 A (BOUCHER LEO E ET AL) 25 February 1969 (1969-02-25) * column 2, line 68 - column 3, line 4 * * column 6, line 46 - line 54 * * column 6, line 70 - line 73 * -----	1-8, 12-18, 20,21	E03F5/10 E04H7/18
X	GB 560 861 A (PAUL WILLIAM ABELES; CHARLES AQUILA VINCENT SMITH; SIEGFRIED JOSEF PIC) 25 April 1944 (1944-04-25) * page 2, line 35 - line 78 * * page 3, line 106 - line 114 * * page 4, line 49 - line 61 * -----	1-8, 12-18, 20,21	
X	FR 2 658 552 A (COMMINGES SARL BETONS) 23 August 1991 (1991-08-23) * the whole document * -----	1-5,7,8, 12-16, 18,20,21	
X	US 1 807 296 A (LAUBHEIMER JOHN G) 26 May 1931 (1931-05-26) * the whole document * -----	1-6, 12-14	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	FR 2 829 517 A (MAISON BLEUE SOC NOUV) 14 March 2003 (2003-03-14) * the whole document * -----	1,2,7,8	E04H E03F
A	US 2002/020131 A1 (HONGYO AKIHIKO ET AL) 21 February 2002 (2002-02-21) * figures 2a,2b * -----	3,4	
A	US 5 248 219 A (HEILER JR LEO J) 28 September 1993 (1993-09-28) * figures 7-10 * -----	1	
A	EP 1 223 248 A (CEMENTATION FOUNDATIONS SKANSK) 17 July 2002 (2002-07-17) * abstract * -----	9-11,19	
1 The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 December 2004	Examiner Flygare, E
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/02 (P04/C01)

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

EP 04 02 3786

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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16-12-2004

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3429473	A	25-02-1969	NONE	
GB 560861	A	25-04-1944	NONE	
FR 2658552	A	23-08-1991	FR 2658552 A1	23-08-1991
US 1807296	A	26-05-1931	NONE	
FR 2829517	A	14-03-2003	FR 2829517 A1	14-03-2003
US 2002020131	A1	21-02-2002	JP 2002061206 A	28-02-2002
US 5248219	A	28-09-1993	US 5114274 A	19-05-1992
EP 1223248	A	17-07-2002	GB 2371069 A	17-07-2002
			EP 1223248 A1	17-07-2002
			US 2002119013 A1	29-08-2002