

Title of the Invention: Improved Inter-connectable Drainage Cell**DESCRIPTION****Technical Field**

[0001] This invention relates to an inter-connectable structural module, particularly, but not exclusively, for use as a drainage module.

Background

[0002] The control and flow of surface water, such as rain water or storm water, is important in preventing the build-up of surface water adjacent foundations of buildings or other structures, and in other areas such as on playing fields, golf courses, landscaped decks, gardens and the like. In densely built up areas, the increased surface run-off of storm and rain water has resulted in massive storm water channels being built to cope with the quantities of run-off water. However, these impervious drainage systems take up large areas of land and are not only an eyesore, but are expensive to build and maintain. Further, they are often polluted by sedimentation and organic rubbish. Storm water channels often smell offensive and can turn into major breeding grounds for pests and diseases.

[0003] One solution to this problem, has resulted in the invention of subsoil modular drainage systems such as the "NORDRAIN"TM subsoil modular drainage system (trade mark of Nortec Geo-Systems (S) Pte Limited of Scotts Road, #05-05 Singapore). The NORDRAIN system comprises a rigid cell including a first and a second substantially parallel planar member, each of which defines an ordered array of circular apertures with a series of columns which are disposed substantially normally to the two parallel surfaces retaining the two members in a fixed spaced relationship from each other. The circular apertures in the first and second planar members are out of register such that the centre of an aperture in the first member is generally opposed to a solid area of the second member disposed between four adjacent circular apertures in the second member.

[0004] Such sub-soil modular drainage systems create a permanent void between a building structure and the soil profile and thus allow easy passage of excess subterranean waters to designated outlets. They are also used in drainage applications for playing fields, golf courses and the like and for making underground storage tanks when they are assembled in a box structure and covered in geotextile.

[0005] One such module is the applicant's existing VERSICELL product which is a structural module which is primarily used for subsurface drainage but can be used for forming tanks for underwater storm water storage and infiltration. The modules can be interconnected together either in a planar arrangement for subsurface drainage or with the modules at 90° to form tanks. While the modules include their own male and female connection means, avoiding the use of separate clips or the like, there is little flexibility in the way the modules interconnect and the modules have to be properly oriented and aligned to connect them together.

[0006] Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present disclosure as it existed before the priority date of each of the appended claims.

[0007] It is an object of the present invention to provide an improved drainage module with improved means for assembling the drainage modules together.

Summary

According to the present invention, there is provided a drainage module comprising:

a first and a second substantially parallel generally planar member retained in a fixed spaced relationship from each other by a plurality of spacers extending between the first and second planar members, the module having four side edges extending between perimeters of the first and second planar members and wherein each planar member defines an ordered array of apertures; and wherein

one or more male interlocking means which are integral with the module project from each of the side edges; and

one or more female interlocking means are defined each of the side edges adapted to receive a male interlocking means so that two modules can be secured together in a side edge to side edge relation;

wherein each side defines the same arrangement of male and female interlocking means each side defining two spaced apart interlocking means of a first type, being male or female, and at least three and preferably four spaced apart locking means of the opposite type to the first, the male and female interlocking means being located such that the modules can be secured together in a side edge to side edge relation, with no overlap, in which relation the male locking means from a first module engages in a female locking means of a second module, with any of the four sides of the first module being engageable with any of the four sides of the second module when the modules are in the same orientation and wherein the additional female interlocking means on each side allow the module to also be assembled in a stepped pattern where the side edges are offset.

[0008] In a preferred embodiment, the female locking means comprise elongate slots defined between the ends of two walls, forming part of the side edges. The slots have two open ends. The male locking means may comprise two arms which are generally L shaped in cross section. When two modules are butt joined and interlocked in end to end relation the ends of the arms engage, behind the walls defining the slots.

[0009] Where there are four female locking means and two male locking means the spacing between the two male locking means will be twice the spacing between adjacent female locking means.

[0010] The apertures are preferably generally circular.

[0011] It is preferred that the area of the apertures comprises at least 50% of the surface area of the first and second planar members.

[0012] It is preferred that the apertures in the planar members are arranged substantially regularly and uniformly.

[0013] In addition to use as a drainage cell, other possible uses for the module include, a drainage layer, a protection layer, a core for covered/uncovered panels, and when assembled as a box structure, as retention/detention tanks, table supports and the like. In addition, the modules may be used as channels/ducts for the flow of liquids, gases, solids having a small particle size, as a protection layer, as a separator, a panel for table tops, or as panels for doors or room partitions, exhibition stands, supports for other structures, or the like. Other uses which benefit from the modules manner of interlocking, fluid permeation characteristics and/or shear, compression and torsional strengths may be envisaged.

[0014] The module may be injection moulded in PP (polypropylene) HDPE (high density polyethylene) or LPDE (low density polyethylene). However, any other suitable materials which can be moulded or cast, may be used, including aluminium and rubber.

Brief Description of Drawings

[0015] Specific embodiments of the present invention will now be described, by way of example only, and with reference to the accompanying drawings, in which:

Figure 1 is an isometric view of a drainage module embodying the present invention:

Figure 2 is a top plan view of the drainage module of Figure 1;

Figure 3 is a side view of the drainage module of Figure 1;

Figure 4 is an isometric view showing two drainage modules connected side to side;

Figure 5 is a top plan view showing two drainage modules connected side to side;

Figure 6 is an isometric view illustrating stepped connection of the modules;

Figure 7 is a detailed top plan view of one side of a module;

Figure 8 is a detailed top plan view of two modules side by side to be joined;

Figure 9 is a detailed top plan view showing the two modules of Figure 8 connected;

Figure 10 is a detailed isometric view of one corner of a module.

Description of Embodiments

[0016] Referring to the drawings, Figures 1 to 3 show a drainage module in the form of a drainage cell 10 embodying the present invention, detailed views of which are shown in Figures 7 to 9. As is best shown in Figure 3, the drainage module includes two planar members, an upper member 12 defining an upper face or top of the module and a lower member 14 defining a lower face or bottom, best seen in Figure 3. As is best seen in Figure 2, a regular and ordered array of circular apertures 16 are defined in both upper and lower members. The size and spacing of the apertures is such that approximately 58% of the area of each of the planar members 12, 14 is open. The arrangement of the apertures on both of the planar members 12, 14 is substantially identical. However, the apertures in the upper member 12 are out of register with those in the lower member 14. A plurality of spacer elements 18 (best seen in Figures 9 and 10) extend between the layers 12, 14 maintaining the layers in spaced apart parallel relationship. Four spacer elements 18 are located on the periphery of each circular aperture 16, spaced 90° apart. As shown in Figure 1, a coloured circle, typically yellow, 20 is defined in the centre of the upper member to indicate that the module is the right way up – i.e. the top of the module faces upwards. A triangular hole is shown on one edge of the ring and on one edge of the module at 21 and this receives a brightly coloured plastic marker (not shown) to indicate to the installer which face 12 should face upwards.

[0017] The forming of the modules with the apertures out of register, enables the entire structure to be injection moulded in one piece and also improves the load bearing capabilities of the module. It is preferred that the module is injection moulded in polypropylene or in high or low density polyethylene. However, other suitable

materials may be used. The usual embodiment is 500mm wide x 500mm long, as illustrated, and 30mm deep, although modules might be made in other sizes.

[0018] As is best seen in the Figures 2 and 3 two male engagement means 22 also referred to as locking means, are provided along the side edge areas of each side 24 of the module. Each of the four sides 24 (refer to Figure 3) is identical.

[0019] As is best seen in Figure 7, each of the male engagement means 22 includes two arms 25 which extend outwardly from the side wall in a direction perpendicular to the end wall before bending generally parallel to the end wall so that in plan view (see Figure 7) each of the arms is generally L shaped. A cross member 26 (refer to Figure 10) extends between the two arms of each male engagement means. This cross member assists in preventing the two arms from flexing or twisting.

[0020] Projections 28 are provided along one bottom edge of the side wall 24 on either side of the male engagement means: these help to prevent movement/play between adjacent modules when they are inter-engaged.

[0021] The female engagement means 40 which are best seen in Figures 7, 8 and 10 comprise slots 42 for receiving the arms of the male engagement means having two open ends 44 and 46, best seen in Figure 10. Having two open ends means that the modules can be connected with each other by sliding the male engagement means 22 into either end of the slots 42. Each slot has an shoulder or wall portion 48 extending along each edge to partially close the slot, and prevent lateral disengagement of the male engagement means from the slot.

[0022] Between the ends of the module and the male and female engagement means there are a series of closed tapered cells 50, 52 which alternate between cells 50 which are closed at their top and cells 52 which are closed at their base, as is best seen in Figure 10.

[0023] As can best be seen in Figure 3, the male and female engagement means are spaced along the sides of the module. Also, as is best seen in Figure 3, the male and female engagement means are asymmetrically disposed on the sides of the module. On each side there are four female engagement means and two male engagement means. The first female engagement means 40A is disposed 3 closed cells from the left hand side of the module counting the upper apertures only. There is a gap of 5 closed cells before the first male engagement means 22A, then one closed cell between it and the second female engagement means 40B. There are then 7 closed cells to the next female engagement means 40C and a gap of 5 closed cells between 40C and the second male engagement means 22B. There is then one closed cell between 22B and the final female engagement means 40D, which in turn is one closed cell from the end of the side.

[0024] When viewed front on, the upper and lower surfaces of the male engagement means are rounded so that the front profile of the male engagement means fits within an imaginary circle which is approximately the same size as the apertures 16, preferably very slightly larger so as to provide an interference push fit with the aperture.

[0025] The described module has a number of distinct modes of inter-fitting with other modules.

[0026] First, when it is desired to interlock two modules 10 in end to end relationship, as shown in Figures 4 and 5, two modules are located side face to side face. Importantly as long as the module is oriented correctly with the upper face uppermost any one side of the module will lock with any one side of the other module. The slots of the female engagement means are positioned above or below the male engagement means and the means are slid together. The end portions of the arms of the male engagement means slot behind the shoulders of the female engagement means to engage and lock the two modules together. In this arrangement the modules are butt joined interlocked. Figures 8 and 9 show the connection of two adjacent modules 10. The modules will typically rest on a surface the female members can be open at both ends without affecting the connection in use.

[0027] The modules may also be connected in a stepped arrangement as illustrated in Figure 6. The stepped arrangement may be out of register by one quarter of the side length as shown in Figure 6, or one half of the side length (not shown). The stepped arrangement allows for a greater range of installations including internal corners and irregular angled layouts, and the like.

[0028] The modules may also be engaged at 90° to each other (not shown) with the male engagement means, forming an interference fit in the cylindrical apertures 16 thereby retaining the members together. When installing a drainage module against a retaining wall, the vertically oriented module 3 can thus be simply interlocked with the horizontal module on which it rests.

[0029] The modules of the present invention may also be used to form underground storage tanks. The modules can be interlocked to form a box having no ends. Custom made ends and centre sections, may then be fitted to stabilise and give rigidity to the box and the box may then be covered with a geotextile to form an underground storage tank.

[0030] Advantageously, unlike existing modules as the four sides are identical, the module can be connected side by side with another module in any orientation, as illustrated in Figures 4 and 5, provided that the module is the correct way up. Furthermore as discussed above, the module may also be connected in a stepped arrangement as shown in Figure 6 which is not possible with existing modules. As discussed above, the stepped arrangement increases flexibility in using the modules. The stepped connection increases the overall strength and resilience of the connected modules against lateral forces.

[0031] Although two male members and four female members is disclosed, it will be appreciated that both the side edge to side edge engagement and stepped connections could be achieved if there were just three female members or more than four female members. If only three female members were provided only one stepped arrangement would be available. The provision of male and female members could be reversed with

two female and four male, provided that the cells were large enough to receive the unconnected male members. Having more female than male members is preferred.

[0032] It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the above-described embodiments, without departing from the broad general scope of the present disclosure. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS

1. A drainage module comprising:

a first and a second substantially parallel generally planar member retained in a fixed spaced relationship from each other by a plurality of spacers extending between the first and second planar members, the module having four side edges extending between perimeters of the first and second planar members and wherein each planar member defines an ordered array of apertures; and wherein

one or more male interlocking means which are integral with the module project from each of the side edges; and

one or more female interlocking means are defined each of the side edges adapted to receive a male interlocking means so that two modules can be secured together in a side edge to side edge relation;

wherein each side defines the same arrangement of male and female interlocking means each side defining two spaced apart interlocking means of a first type, being male or female, and three or more spaced apart locking means of the opposite type to the first, the male and female interlocking means being located such that the modules can be secured together in a side edge to side edge relation, with no overlap, in which relation the male locking means from a first module engages in a female locking means of a second module, with any of the four sides of the first module being engageable with any of the four sides of the second module when the modules are in the same orientation and wherein the additional female interlocking means on each side allow the module to also be assembled in a stepped pattern where the side edges of the two modules are offset.

2. A drainage module as claimed in claim 1 wherein the second type are female interlocking means which comprise elongate slots defined in side edges of the module and the slots are open at both ends.

3. A drainage module as claimed in claim 1 or 2 wherein the first type are male interlocking means which comprise two arms which are generally L shaped in planar cross section whose distal ends locate behind the side edges adjacent the elongate slot when two modules are interlocked in side edge to side edge relation.
4. A drainage module as claimed in any one of claims 1 to 3 wherein there are four or more spaced apart locking means of the opposite type on each side.
5. A drainage module as claimed in any one of claims 1 to 4 wherein there are four interlocking means of the second type and two interlocking means of the first type and the spacing between the two of the first type of interlocking means is twice the spacing between two adjacent female locking means.
6. A drainage module as claimed in any one of the preceding claims wherein the apertures are generally circular and the perimeter of the male locking means is also generally circular.
7. A drainage module as claimed in any one of the preceding claims wherein the area of the apertures comprise at least 50% of the surface area of the first and second planar members.
8. A drainage module as claimed in any one of the preceding claims wherein the size and configuration of the male interlocking means relative to the size and configuration of the apertures, is such that a first module may also be inter-engaged with a second module, with the first module oriented generally normally to the second module with a side edge of the first module abutting a planar member of the second module and with each male interlocking means defined along said side edge of the first member extending into one of the apertures defined in one of the planar members in a close or interference type fit with the aperture.
9. A drainage module as claimed in any one of the preceding claims wherein the apertures in the planar members are arranged substantially regularly and uniformly.

10. A drainage module as claimed in any one of the preceding claims wherein a series of gaps or cells are also disposed along the side edge of the modules between the interlocking means, the gaps/cells being wider than the male members.