

Description

The present invention relates to the provision of adequate drainage by artificial means and has particular application in the area of landscape gardening.

Known methods of draining relatively large surface areas where the funnelling of water directly into narrow diameter pipes is impractical or impossible involve the use of a layer of stone or gravel capable of supporting the surface to be drained. Water from this "gravel" layer may then be allowed to percolate into the ground below, follow the lie of the land through said gravel to further conventional drainage channels or pipes or otherwise evacuated. In the case of a roof-top garden for example a concrete roof-top may be provided with a water impervious membrane opening into conventional channels, gutters or drains; a layer of pebbles may then be provided over such membrane followed by a filter membrane over such layer of pebbles over which filter membrane a layer of soil is laid in which vegetation may be grown.

The filter membrane prevents the soil clogging the layer of pebbles thereby preventing drainage; the layer of pebbles facilitates drainage of the soil and hence adequate oxygen for the roots of vegetation. The lower impervious membrane in turn prevents the ingress of moisture to the building or structure below.

Such a system as lastmentioned involving pebbles, gravel or stone has been found to have various defects particularly in roof-top applications. The lastmentioned conventional system may be expensive insofar as stones or pebbles are heavy thus presenting transportation problems to high or inaccessible locations, the weight also may dictate otherwise unnecessary reinforcement of the supporting structure. It has been further found that where a water impervious membrane is employed below a layer of pebbles the pebbles often breach the water tight integrity of such membrane due to sharp edges and/or excessive weight. The conventional system as lastmentioned furthermore makes no provision for the deployment of conduits for water or power through the drainage area particularly where such conduits are to be laid after the drainage system is in existence.

It has been proposed in German Patent Specification 2521374 to provide a cell structure to serve as a drainage means which can be used in landscape gardening. The cell structure comprises essentially a pair of plates which are arranged in parallel. The plates have spacers and also a means for connecting the plates. The plates may also have upstanding projections which serve as feet, and finally small perforations are provided in the plates to enable the passage therethrough of water and gases. The said perforations are relatively small in size, and are arranged in a regular pattern on the sections of the plate between the projections. Because the perforations are small, the extent to which water and gas

can pass therethrough is limited. The structure does not lend itself to increasing the size of the perforations because such a step would result in a weakening of the rigidity of the structure.

The present invention seeks to ameliorate one or more of the lastmentioned disadvantages with the prior art or at least provide the consumer with a choice.

According to the present invention there is provided a rigid cell structure comprising first and second substantially parallel perforate planar members maintained in a fixed relationship from each other by means of a plurality of spacer members which are disposed so that gases or liquids may freely pass through the cell structure around the spacer means in any direction; wherein the perforations in the planar members comprise at least 40% of their surface area, and all areas between the perforations are supported directly by the spacer members for load bearing at a loading of at least 20 kg per square metre.

The present invention also teaches a method of providing drainage utilising the lastmentioned apparatus. In addition to roof-top garden applications it is envisaged that the invention may be of use to provide drainage under roadways, under embankments and elsewhere where surface erosion would otherwise be a problem.

One example of an article in accordance with the present invention will now be described with reference to the accompanying drawings wherein:

Figure 1 is a part perspective view of a cell in accordance with the present invention;

Figure 2 is a further part perspective view of the cell of figure 1;

Figure 3 is a side elevation of the cell depicted in figures 1 and 2.

Figure 1 depicts a drainage cell comprising a first planar perforate surface 1 and a second planar perforate surface 2 maintained in parallel spaced relationship to each other by a plurality of upright spacer members 3.

The nature of perforations in the embodiment of figures 1 and 2 may best be observed from figure 2 which clearly depicts substantially square perforate areas 4 in the first planar surface 1. It will be noted that the square perforate areas are interposed with substantially square load bearing sections 5 such that the resulting configuration of the first planar surface 1 is checkered. In this embodiment the second perforate planar surface is of the same configuration as the first perforate planar surface except that the square perforate sections are out of register with each other such that directly beneath each square perforate section of the first perforate planar surface lies a square load bearing section of the second planar perforate surface.

It will be appreciated that a configuration as above described results in planar surfaces having

approximately fifty per cent of their surface area devoted to perforations and the remaining fifty per cent devoted to a surface which is capable of load bearing. In say a roof-top application where a membrane may be employed above the cell adjacent the first perforate planar surface and possibly additionally beneath the cell it is important that the load bearing surfaces comprise a significant proportion of the planar surfaces in order that loads may be distributed. If this were not the case then the cell might perforate adjacent membranes thereby destroying their effectiveness. Where the cell is laid directly for example on a bitumenised roof (not shown) this feature is particularly important as it would not be appropriate for the spacer members 3 to bear directly on the bitumenised surface thereby allowing perforation of the bitumenised surface when a load was applied to the upper surface of the cell.

It will be appreciated that the spacer members 3 are rectangular in configuration and are (when viewed in transverse section) are oriented diagonally of the square pattern associated with the planar surfaces so that the ends of such spacer members 6 form bridges between adjacent load bearing surfaces thereby tying in adjacent load bearing surfaces to each other and ensuring a coherent rigid structure.

Some bracing of the spacer members 3 is achieved by low upstanding walls 7 inwardly directed from the planar perforate surfaces running between adjacent spacer members and extending along the edges defining the square load bearing surfaces.

It will be noted that these small upstanding walls 7 define shallow areas 8 which are capable of holding small amounts of pooled liquid. This is an important feature where the cell is used for drainage of say a roof-top garden as during periods where no water flow is present the water in such areas may evaporate thereby assisting to maintain the roots of any plants or grass above the drainage cell in a moist condition conducive to plant life.

Whilst it is envisaged that the primary function of the drainage cell will be to accept water through its first and upper perforate planar surface and to allow free percolation of the water through the cell towards a drain (not shown) beneath the cell it should be appreciated that the cell additionally assists in maintaining oxygen adjacent the roots of any plants above the upper planar surface. It should be noted that the nature of the spacer members permits free flow of water and oxygen in any horizontal direction within the cell and therefore it is usually not necessary to orient the cell in any particular direction with respect to the fall of the surface over which it is installed. The relatively open nature of the area between the two planar surfaces additionally may provide space through which conduits may be passed for various services which may be associated with a building.

Lines 8 depicts the possible directions for flow of

water entering the upper surface of the cell and flowing through the cell. The cell may advantageously be fabricated from one of a number of plastic materials in a unitary configuration and in this regard polypropylene has been found to be appropriate.

The multiplicity of spacer members 3 together with walls 7 results in a relatively rigid structure which is capable of supporting substantial loads and for example where the spacer members are approximately thirty millimetres in length and three millimetres by three millimetres in cross-section the load bearing capabilities of the upper planar surface where the lower planar surface is supported on a concrete slab is approximately 38,000 kilograms per square metre.

The embodiment of figure 1 is approximately three hundred millimetres by three hundred millimetres square and in order to cover a large surface a number of drainage cells may be laid beside each other.

It should be appreciated that the present invention provides a light drainage cell which permits large volumes of water to be drained beneath a variety of surfaces and may furthermore enhance growth of vegetation above the cell.

Although it is not depicted herein those skilled in the art of drainage will note that a filter membrane should be utilised above a cell in accordance with the present invention due to the large apertures in the upper perforate planar surface and in this regard "ter-raferma" brand polyester membranes are appropriate.

From figure 2 it may be observed that the edges of the drainage cell are not perfectly straight but comprise a series of tongues 10 and grooves 11. These tongues and grooves in the edges of one cell member facilitate a fairly precise location of adjacent cells where cells are placed side by side so as to form a large mat. This is due to the fact that the tongues 10 of one cell will fit into the grooves 11 of an adjacent cell thereby preventing relative horizontal movement between adjacent cells provided they are urged towards each other.

Claims

1. A rigid cell structure comprising first and second substantially parallel perforate planar members (1, 2) maintained in a fixed relationship from each other by means of a plurality of spacer members which are disposed so that gases or liquids may freely pass through the cell structure around the spacer means in any direction (3); characterised in that the perforations (4) in the planar members (3) comprise at least 40% of their surface area, and in that all areas (5) between the perforations (4) are supported directly by the spacer members (3) for load bearing at a loading of at least 20 kg per square metre.



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2. A structure in accordance with Claim 1 characterised in that spacer member (3) adjoins at each end, walls (7) which in turn adjoin the ends of adjacent spacer members (3); the orientation of the walls (7) being perpendicular to the plane of the parallel perforate planar members (1, 2); the walls (7) thereby serving to brace the entire structure and assist in transferring local stresses throughout the structure.

3. A structure in accordance with Claim 1 characterised in that the spacer members (3) are columnar in configuration and disposed substantially normally to the two parallel perforate planar members (3).

4. A structure in accordance with any one of the preceding claims characterised in that the perforations (4) are formed as parallelograms interposed with load bearing areas (5) of like configuration and dimensions in a checkered configuration; the spacer members (3) being joined to the perforate planar members (1, 2) adjacent the corners of such parallelogram shaped load bearing areas (5) and perforations (4).

5. A structure in accordance with any one of the preceding claims characterised in that the perforations (4) are of a substantially square configuration interposed with substantially square load bearing areas (5) of similar dimensions in a checkered configuration; the spacer members (3) being joined to the perforate planar members (1, 2) adjacent the corners of such square areas (5).

6. A structure in accordance with any one of the preceding claims characterised in that the perforations (4) of one perforate member (1) are out of register with the perforations (4) of the opposing perforate member (2).

7. A structure in accordance with any one of the preceding claims characterised in that at least one of the planar perforate members (1) includes upon its internally facing side a plurality of low upstanding walls (7) extending between adjacent spacer members (3) defining shallow areas (8) adapted to trap small quantities of liquid.

8. A structure in accordance with any one of the preceding claims characterised in that the cell structure is of adequate strength to ensure that either one of the perforate planar members (1, 2) has a load bearing capability of between 15,000 and 90,000 kilograms per square metre when the opposing perforate planar member (1, 2) is supported by a rigid planar surface.

9. A rigid structure in accordance with any one of the preceding claims characterised in that there is a regular pattern of shallow tongues and grooves along the peripheral edges of the structure to allow the structures to be interlocked when assembled into a mat.

Patentansprüche

1. Formstabile Zellstruktur mit ersten und zweiten, im wesentlichen parallelen, mit Perforationen versehenen, ebenen Bauteilen (1, 2), die in einer festen gegenseitigen Lage mittels einer Vielzahl von Abstandshaltern gehalten werden, welche derart angeordnet sind, daß Gase oder Flüssigkeiten durch die Zellstruktur rund um die Abstandshalter in jeder Richtung ungehindert hindurchtreten können, dadurch gekennzeichnet, daß die Perforationen (4) in den ebenen Bauteilen (1, 2) wenigstens 40% von deren Oberfläche ausmachen und daß alle Bereiche (5) zwischen den Perforationen (4) für die Lastaufnahme bei einer Belastung von wenigstens 20 kg/m² unmittelbar von den Abstandshaltern (3) gestützt werden.

2. Struktur nach Anspruch 1, dadurch gekennzeichnet, daß jeder Abstandshalter (3) an jedem Ende an Wände (7) anstößt, die ihrerseits an die Enden benachbarter Abstandshalter (3) anstoßen, daß die Wände (7) senkrecht zu der Ebene der parallelen, mit Perforationen versehenen, ebenen Bauteile (1, 2) orientiert sind, und daß die Wände (7) dazu dienen, die gesamte Struktur auszusteifen und örtliche Beanspruchungen auf die gesamte Struktur übertragen zu helfen.

3. Struktur nach Anspruch 1, dadurch gekennzeichnet, daß die Abstandshalter (3) säulenförmig ausgebildet und im wesentlichen normal bezüglich der beiden parallelen, mit Perforationen versehenen, ebenen Bauteile (1, 2) angebracht sind.

4. Struktur nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Perforationen (4) parallelogrammförmig ausgebildet und zusammen mit Lastaufnahmebereichen (5) von gleicher Form und Abmessung in eine geschachtelte Konfiguration eingefügt sind, und daß Abstandshalter (3) an die mit Perforationen versehenen, ebenen Bauteile (1, 2) in der Nähe der Ecken der parallelogrammförmigen Lastaufnahmebereiche (5) und Perforationen (4) anstoßen.

5. Struktur nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Perforationen (4) eine im wesentlichen quadratische Form aufweisen und mit im wesentlichen quadratischen Lastaufnahmebereichen (5) ähnlicher Abmessungen in eine geschachtelte Konfiguration eingefügt sind, und daß die Abstandshalter (3) an die mit Perforationen versehenen, ebenen Bauteile (1, 2) in der Nähe der Ecken dieser quadratischen Bereiche (5) anstoßen.

6. Struktur nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Perforationen (4) des einen mit Perforationen versehenen Bauteils (1) versetzt zu den Perforationen (4) des gegenüberliegenden, mit Perforationen versehenen Bauteils (2) angeordnet sind.



7. Struktur nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß wenigstens eines der mit Perforationen versehenen Bauteile (1, 2) auf seiner nach innen gewandten Seite eine Vielzahl niedriger, nach oben stehender Wände (7) aufweist, welche zwischen benachbarten Abstandshaltern (3) verlaufen und Muldenbereiche (8) zum Auffangen geringer Flüssigkeitsmengen begrenzen.

8. Struktur nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Zellstruktur ausreichend stabil ist, um zu gewährleisten, daß jedes der mit Perforationen versehenen, ebenen Bauteile (1, 2) ein Lastaufnahmevermögen zwischen 15.000 und 90.000 kg/m² aufweist, wenn das gegenüberliegende, mit Perforationen versehene Bauteil auf einer stabilen, ebenen Fläche aufliegt.

9. Struktur nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß längs der Umfangskanten der Struktur ein regelmäßiges Muster flacher Nut- und Federfugen vorgesehen ist, um eine Verriegelung der Strukturen bei ihrem Zusammenbau zu einer Matte zu gestatten.

Revendications

1. Structure de cellule rigide comprenant des premier et second éléments plans perforés et sensiblement parallèles (1, 2) maintenus fixes l'un par rapport à l'autre au moyen d'une pluralité d'éléments entretoises (3) qui sont placés de manière que les gaz ou les liquides puissent passer dans la structure cellulaire autour des moyens entretoises dans toutes les directions ; caractérisée en ce que les perforations (4) dans les éléments plans (3) comprennent au moins 40% de leur surface et en ce que toutes les surfaces (5) entre les perforations (4) sont supportées directement par les éléments entretoises (3) pour porter la charge à une charge d'au moins 20 kg par mètre carré.

2. Structure suivant la revendication 1 ; caractérisée en ce que les éléments entretoises (3) rejoignent, à chaque extrémité, des parois 7 qui, à leur tour, rejoignent les bouts des éléments entretoises adjacents (3) ; l'orientation des parois (7) étant perpendiculaire au plan des éléments plans perforés et parallèles (1, 2) ; les parois (7) servant ainsi à raidir la structure entière et à aider en transférant des tensions locales dans la structure.

3. Structure suivant la revendication 1 ; caractérisée en ce que les éléments entretoises (3) sont des colonnes dans leur allure et placées sensiblement normales aux deux éléments plans, perforés et parallèles.

4. Structure suivant l'une des revendications précédentes ; caractérisée en ce que les perforations (4) ont la forme de parallélogrammes interposés avec

des surfaces de support de charge (5) de même configuration et des dimensions dans une configuration en damier ; les éléments entretoises (3) étant joints aux éléments plans et perforés (1, 2) adjacents aux coins de surfaces (5) de support de charge en forme de parallélogramme et des perforations (4).

5. Structure suivant l'une des revendications précédentes ; caractérisée en ce que les perforations (4) ont une configuration sensiblement carrée interposées avec des surfaces de support de charges sensiblement carrées (5) de dimensions similaires en configuration de échiquier ; les éléments entretoises (3) étant joints aux éléments plans et perforés (1, 2) adjacents aux coins de ces surfaces carrées (5).

6. Structure suivant l'une des revendications précédentes ; caractérisée en ce que les perforations (4) d'un élément perforé (1) sont décalées par rapport aux perforations (4) de l'élément perforé opposé (2).

7. Structure suivant l'une des revendications précédentes ; caractérisée en ce qu'au moins l'un des éléments perforés plans (1) comprend, sur le côté de sa face interne, une pluralité de parois (7) basses verticales allant entre les éléments entretoises (3) définissant des zones peu profondes (8) adaptées pour pléger des petites quantités de liquide.

8. Structure suivant l'une des revendications précédentes ; caractérisée en ce que la structure de cellule a une résistance mécanique adéquate pour assurer que l'un des éléments plans perforés (1, 2) a une possibilité de support de charge entre 15000 et 90000 kilogrammes par mètre carré quand l'élément plan perforé opposé (1, 2) est supporté par une surface plane rigide.

9. Structure rigide suivant l'une des revendications précédentes ; caractérisée en ce qu'il existe un dessin régulier de languettes et de gorges peu profondes sur les bords périphériques de la structure pour permettre aux structures d'être verrouillées ensemble quand elles sont assemblées dans une natte.