

A PLANT TRAY

FIELD OF INVENTION

The invention relates to a plant tray suitable for landscaping, and in particular, to a
5 plant tray suitable for use in vertical landscaping.

BACKGROUND TO THE INVENTION

The following discussion of the background to the invention is intended to facilitate
an understanding of the present invention. However, it should be appreciated that the
10 discussion is not an acknowledgment or admission that any of the material referred to
was published, known or part of the common general knowledge in any jurisdiction as
at the priority date of the application.

Urban heat island effect (UHIE) refers to the phenomenon when city temperatures
run higher than those in suburban and rural areas. UHIE occurs primarily due to the
15 growing numbers of buildings being built as a consequence of urbanization and
economic growth, and these growing numbers of buildings have supplanted
vegetation and trees previously filling the city area. In addition, human activities
generate heat and such generation of heat contributes to the rise in city
temperatures.

20 In an attempt to reduce the adverse influence of the UHIE, vegetations are grown
on rooftops (i.e. green roof) to compensate for the loss of supplanted vegetation and
trees. The vegetations serve to filter greenhouse gases such as carbon dioxide and
other toxins in the city. It has been studied and demonstrated that such green roofs
help to reduce roof ambient temperature and that heat transfer from the roof to the
25 rooms directly underneath the roof is lowered. A reduced ambient temperature and a
lowered heat transfer from the roof to the rooms directly underneath the roof may
result in lesser dependence on air-conditioning, thereby lessening the building's
energy consumption.

In a typical green roof system, plants are conveniently housed in individual plant trays connected together to provide a larger surface area of greenery. Even though plant trays are commonly found in a variety of different sizes and shapes, most of them, if not all, are configured in almost the same way, that being a container (conveniently a box-shaped design) having an orifice near the bottom end of a side wall of the plant tray as a drainage means. The drainage means allows excess fluids such as water, fertilizers, chemicals and other liquids poured into the plant soil or plant substrate to advantageously drain out of the plant tray instead of building up in the plant tray and harming the plant (i.e. root rot, leaching of nutrients and the like). Nevertheless, during periods where heavy rains are frequent, or when there is unintentional excessive watering of plants, the excess fluids may carry soil, small pebbles, particles, coagulates or debris along leading to blockage of the drainage means. This creates the same built-up problems whereby the orifices are provided in the first place. On the other hand, during periods of drought or in the absence of regular watering, there is no provision to retain any amount of water in the plant tray since excess water has already been drained away previously.

Therefore, it is desirable to provide for a plant tray that overcomes, or at least alleviates, the above problems.

SUMMARY OF THE INVENTION

Throughout this document, unless otherwise indicated to the contrary, the terms "comprising", "consisting of", and the like, are to be construed as non-exhaustive, or in other words, as meaning "including, but not limited to".

In a first aspect of the present invention, there is provided a plant tray for use in landscaping, comprising:

- a hollow body having an open top end and a closed bottom end, the hollow body defined by at least one side wall and a bottom wall;
- a fluid retention section in which the roots of plants can be housed and in which fluid can be retained, the fluid retention section located within the hollow body; and

- a fluid drainage section in which an overflow of fluid can be drained, the fluid drainage section located within the hollow body;

wherein the fluid retention section contains a plurality of fluid retention sub-sections arranged such that a fluid passageway is formed to allow uniform distribution of fluid
5 within the fluid retention section.

BRIEF DESCRIPTION OF THE DRAWINGS

In the figures, which illustrate, by way of example only, embodiments of the present invention,

10 **FIG. 1** shows a perspective view of the interior of a plant tray according to a first aspect of the invention.

FIG. 2a shows the different layers to be placed in the plant tray.

FIG. 2b shows a perspective view of the exterior of the plant tray of **FIG. 1**.

FIG. 3a shows a plan view of the plant tray of **FIG. 1**.

15 **FIG. 3b** shows a perspective view of the bottom of the exterior of the plant tray of **FIG. 1**.

FIG. 4a-d show a perspective view of the plant tray of **FIG. 1** being employed in vertical landscaping.

20 **FIG. 5** shows schematically the arrangement of the plant trays in vertical landscaping with the flow of fluid through the plant trays.

DETAILED DESCRIPTION

The invention relates to a plant tray suitable for landscaping, and in particular, to a plant tray suitable for use in vertical landscaping.

25 In accordance with a first embodiment of the invention illustrated in **FIG. 1**, there is provided a plant tray **1** for use in landscaping. The plant tray **1** comprises a hollow

body **2** having an open top end and a closed bottom end. The hollow body **2** is defined by four side walls **3a-d** and a bottom wall **4** in a rectangular-shaped box. Although a convenient open top box-shaped plant tray has been described herein, it is to be understood that the plant tray may be formed of other shapes, such as open
5 top cylinder whereby the hollow body **2** is defined by one side wall **3** and a bottom wall **4**.

A fluid retention section **5**, in which the roots of plants can be housed and in which fluid such as water, fertilizers and chemicals can be retained, is located within the hollow body **2**. Conveniently, the fluid retention section **5** is defined by the side walls
10 **3a-d** and the bottom wall **4** of the hollow body **2**. Alternatively, the fluid retention section **5** may be formed of a separate workpiece having side walls and bottom wall, and fitted within the hollow body **2**.

The fluid retention section **5** contains a plurality of fluid retention sub-sections **6** disposed within the fluid retention section **5**. The fluid retention sub-sections **6** may
15 be formed by dividing the fluid retention section **5** into smaller regions by means of panel walls **7** or ribs. The fluid retention sub-sections **6** are arranged such that a fluid passageway is formed to allow uniform distribution of fluid within the fluid retention sub-sections **6**. This could be achieved by forming open fluid retention sub-sections **6** whereby fluid may flow freely from a first fluid retention sub-section to a second fluid
20 retention sub-section such that the fluid level in each of the fluid retention sub-section **6** is the same. Preferably, one end of the panel wall **7** runs from one of the side walls **3a-d** and ends abruptly so as not to form a closed region. Preferably, the panel walls **7** are arranged in an interdigitated manner as shown in **FIG. 1**.

A fluid drainage section **8**, in which an overflow of fluid can be drained, is located
25 within the hollow body **2**. The fluid drainage section **8** has an open top end and is defined by four side walls **9a-d** and a bottom wall **10**. An overflow of fluid occurs when the fluid level in the fluid retention section **5** is above the height of the side walls **9a-d** of the fluid drainage section **8**. An orifice **11** for draining away excess fluid is located in the bottom wall **10** within the region enclosed by the four side walls **9a-d**
30 of the fluid drainage section **8**. Preferably, the bottom wall **10** is inclined downwardly from top end of the side walls **9a-d** towards the orifice **11** such that excess fluid is

drained out of the fluid drainage section **8** and therefore out of the plant tray **1** by gravitational force via the orifice **11**. Other configurations of the bottom wall **10** are also possible, such as the bottom wall **10** is inclined downwardly from the side walls **9a-d** at a height above the orifice **11** but below the top end of the side walls **9a-d** towards the orifice **11** such that excess fluid is drained away by gravitational force. Conveniently, the orifice **11** is located centrally in the region enclosed by the four side walls **10** of the fluid drainage section **8**. The orifice **11** may also be located off-centre closer to the side walls **9a-d**. Advantageously, more than one orifice **11** may be provided so that (i) there is faster drainage of excess fluid especially during monsoon seasons, or (ii) in anticipation of blocking of one of the orifices **11**, excess fluid may still be drained away via the remaining orifices **11**. Although a convenient open top box-shaped fluid drainage section **8** has been described herein, it is to be understood that the fluid drainage section **8** may be formed of other shapes, such as inverted open top cone whereby the orifice **11** is located at the apex of the inverted conically-shaped fluid drainage section **8**.

In the embodiment illustrated in **FIG. 1**, the fluid drainage section **8** is conveniently located centrally within the fluid retention section **5**. The fluid drainage section **8** may also be located off-centre within the fluid retention section **5**. Preferably, the fluid drainage section **8** is located within the fluid retention section **5** and a passageway for the fluid around the fluid drainage section **8** is formed so that fluid may flow freely within the fluid retention section **5** such that the fluid level in the fluid retention section **5** is the same. In a further embodiment, the fluid drainage section **8** may be located within the hollow body **2** but outside the fluid retention section **5**. For example, the fluid drainage section **8** may be located adjacent to at least one but not all of the side walls **3a-d** of the hollow body **2** such that the adjacent side walls **3a-d** conveniently form the side walls **9a-d** of the fluid drainage section **8**.

Optionally, a measuring means **16** is provided within the fluid retention section **5** to measure the fluid level retained in the fluid retention section **5**. The measuring means may be a tube inserted into a slot provided in the fluid retention section **5** to receive the tube therein. The advantage of providing a measuring means for the retained fluid level is that maintenance worker is able to find out if there is fluid retained in the

plant tray 1. This would enable the maintenance worker to know whether to add fluid or how much fluid to add to the plant tray 1.

The plant tray 1 is designed to house different layers, such as a grille, a filter and a substrate for the plants, as illustrated in **FIG. 2a**. In the plant tray 1, a grille is first placed on top of the fluid retention section 5 and the fluid drainage section 8. A filter is next placed on top of the grille, followed by a substrate for the plants on top of the filter. A perforated irrigation pipe, or commonly known as an irrigation dripline, is then placed on top of the substrate. Holes (not shown) may be provided at opposing side walls 3a-d to accommodate passage of the irrigation dripline. In such a design, the height of the side walls 3a-d is made taller than the height of the substrate. In the event of heavy rain where there is a continuous sudden influx of large amount of rainwater, the fluid retention section 8 may not have time to drain off the excess rainwater. Due to back-pressure, the substrate may overflow and cause back-splashing. This design therefore gives the advantage that the side walls 3a-d are sufficiently tall to prevent the overflow of the substrate in the event of heavy rain. As shown in **FIG. 2b**, the side walls 3a-d of the fluid retention section 5 are advantageously structured to have tier layers in order to improve the rigidity of the side walls 3a-d and also to provide support for the grille, filter and substrate from the edge of the side walls 3a-d. Another advantage of providing a tier-layered plant tray 1 is the ability to pile up and stack the unused plant trays 1 in a vertical manner thereby saving storage space. The grille will experience the highest loading since it is the bottommost layer supporting the filter and the substrate with plants. Therefore, in order to spread the loading due to the upper layers, preferably the panel walls 7 of the fluid retention section 5, and more preferably the side walls 9a-d of the fluid drainage section 8 are formed of the same height as the edge of the side walls 3a-d of the lowest tier layer supporting the grille.

FIG. 3a shows a plan view of the plant tray 1 illustrated in **FIG. 1**. At the top end of the side walls 3a-d of the hollow body 2, flanges 13a-d are provided for easy handling and carrying of the plant tray 1. Although it is illustrated that flanges 13a-d are provided on each of the side walls 3a-d, it will be understood that flanges may be provided on two opposing side walls instead. To further enhance the ease of handling and carrying of the plant tray 1, grooves 14 may be provided on the

underside of the flanges **13a-d** so as to provide a better grip. The grooves **14** preferably have a C-shaped cut therein to provide a comfortable grip, as shown in **FIG. 3b**. The grooves **14** may also have cuts formed of other configurations, such as a V-shaped cut (not shown), to provide comfortable grip. Advantageously, the plant tray **1** is designed to have an in-built outlet pipe socket **20** at the underside of the plant tray bottom coinciding with the orifice **11** so that a pipe **15** is detachably inserted vertically into the underside of the plant tray bottom via the orifice **11** to facilitate and direct the flow of the drained fluid from the plant tray **1**. As mentioned in previous paragraph, the plant tray **1** may be stacked together in a vertical orientation when not in use, and the pipe **15** is designed such that it is detachable from the plant tray **1**.

FIG. 4a shows two plant trays **1** being placed together side-by-side. To fasten the plant trays **1** securely, the flanges **13a-d** are provided with holes. In a preferred embodiment, at the line of joining the two plant trays, the flange of one side of the first plant tray overlaps with the flange of one side of the second plant tray such that the holes in both flanges coincide. The flanges of the plant trays which overlap with one another may be designed in such a way that the flange of the first plant tray is located higher than the flange of the second plant tray while maintaining the overall height of the plant trays. Fastening means such as screws and nuts are inserted through the holes to fasten the plant trays **1** securely. In vertical landscaping where the plant trays **1** are placed in supporting structures mountable onto a building facade as shown in **FIG. 4a-d**, a flat bar of the supporting structure, which holds the plant trays in place along the flanges of the plant trays, is provided with holes and the holes coincide with the holes provided in the flanges. Other than flat bars, angle bars, for instance, may also be used for holding the plant trays in place. Fastening means such as bolts and nuts are inserted through the holes to fasten the plant trays **1** and the flat bar securely. Optionally, meshes are provided above the plant trays **1** to provide support for and facilitate the growth of climber plants as illustrated in **FIG. 4d**. An advantage of designing the integrated supporting structure with the meshes and the plant trays is that it allows this integrated structure to be modular and further allows off-site pre-propagation of climber plants. In this way, the modular integrated

structure can be transported to site and simply be mounted onto the building facade to achieve instant greening.

FIG. 5 shows schematically the arrangement of the plant trays in vertical landscaping with the flow of fluid through the plant trays. In this illustration, water is supplied from the top of the plant trays via irrigation pipes. Excess water is drained away from the bottom of the plant trays via the pipes **15** inserted into the orifices **11**. The pipes **15** at the bottom of the plant trays are connected via a discharge line to collectively discharge excess water from the system. The excess water discharged from the system may be stored in a water storage tank (not shown) and reused again. For instance, the water supplied from the top of the plant trays via irrigation pipes may come from the discharged water stored in the water storage tank, thereby reducing the dependency on fresh water supply. Many existing buildings have in-place rainwater downpipes to drain away excess rainwater from the building. The system described above is particularly advantageous when the discharge line is made complimentary to the existing rainwater downpipes so that more water may be stored in the water storage tank to further reduce the dependency on fresh water supply. Further, the plant trays **1** can be used as filtering system for unwanted particles inevitably collected by the rainwater at the rooftop of the buildings.

The afore-described plant tray provides the possibility of vertical drainage of excess fluid suitable for vertical landscaping. The plant tray can be placed on flat surface and excess fluid may be drained easily by gravitational force without further mechanical means. The panel walls of the fluid retention section are designed to allow free circulation of fluid in the fluid retention section such that a uniform level of fluid may be maintained. At the same time, in-built fluid retention section is provided in the plant tray to retain fluid for subsequently use, particularly during periods of low fluid supply, rendering the plant tray unique and suitable for vertical landscaping. The depth of the plant tray in this design is also generally deeper to enable the growth of climber plants which require deeper substrates. In addition, the plant trays could be designed to have narrower width so as to reduce the area required for installation and to reduce wastage of materials for the plant trays.

It is to be understood and appreciated that the use of the plant tray described above is not limited to vertical landscaping. For instance, the plant trays may be horizontally connected in series and used for hybrid greening such as growing shrubs on the rooftops of buildings or along corridors. In such circumstances, at least one of the side walls **3a-d** of the hollow body **2** of the plant tray **1** may be provided with an orifice (not shown) near the bottom wall **4**. Preferably, the orifice is provided at a height slightly above the fluid retention section **5**. Connecting pipes (not shown) are inserted into the orifices located at the side walls **3a-d** to thereby connect the plant trays in a horizontal arrangement. The orifice **11** located at the bottom wall **4** may be sealed up, for example, with a rubber stopper. In the event that one of the plant trays receives a sudden influx of large amount of rainwater, the excess rainwater may be re-distributed to neighbouring plant trays via the connecting pipes such that the drainage of excess rainwater is now horizontal.

Although the foregoing invention has been described in some detail by way of illustration and example, and with regard to one or more embodiments, for the purposes of clarity of understanding, it is readily apparent to those of ordinary skill in the art in light of the teachings of this invention that certain changes, variations and modifications may be made thereto without departing from the spirit or scope of the invention as described in the appended claims.

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I CLAIM:

1. A plant tray for use in vertical landscaping, comprising:
 - a hollow body having an open top end and a closed bottom end, the hollow body defined by at least one side wall and a bottom wall;
 - 5 – a fluid retention section in which the roots of plants can be housed and in which fluid can be retained, the fluid retention section located within the hollow body, the fluid retention section formed by a separate workpiece having a plurality of side walls and a bottom wall, the separate workpiece being fitted within the hollow body; and
 - 10 – a fluid drainage section in which an overflow of fluid can be drained, the fluid drainage section located within the hollow body, wherein the fluid drainage section comprises a open top and is defined by at least one side wall and a bottom wall and further comprises at least one orifice located in the bottom wall;
 - 15 wherein the fluid retention section contains a plurality of fluid retention sub-sections arranged such that a fluid passageway is formed to allow uniform distribution of fluid within the fluid retention section.
2. The plant tray of claim 1, wherein the hollow body is defined by four side walls and a bottom wall, thereby forming a rectangular-shaped box.
- 20 3. The plant tray of claim 1 or 2, wherein the plurality of fluid retention sub-sections are defined by a plurality of panel walls each running from one of the side walls and each ending abruptly so as not to form a closed region.
4. The plant tray of claim 3, wherein the panel walls are arranged in an interdigitated manner.
- 25 5. The plant tray of any one of the preceding claims, wherein the orifice is located centrally in the region enclosed by the at least one side wall.

6. The plant tray of any one of the preceding claims, further comprising a pipe socket for receiving a drainage pipe, the pipe socket located on the underside of the bottom wall of the fluid drainage section and coinciding with the orifice.
7. The plant tray of any one of the preceding claims, wherein the bottom wall
5 inclines downwardly from the at least one side wall at a height above the orifice but below top end of the side wall towards the orifice.
8. The plant tray of any one of the preceding claims, wherein the bottom wall inclines downwardly from top end of the at least one side wall towards the orifice.
- 10 9. The plant tray of any one of the preceding claims, wherein the fluid drainage section is located within the fluid retention section.
10. The plant tray of any one of the preceding claims, wherein the fluid drainage section is located outside the fluid retention section and is located adjacent to at least one but not all of the side walls of the hollow body.
- 15 11. The plant tray of any one of the preceding claims, further comprising a measuring means in the fluid retention section.
12. The plant tray of claim 11, wherein the fluid retention section further comprises a slot for receiving the measuring means.
13. The plant tray of any one of the preceding claims, wherein the side walls of the
20 fluid retention section are structured to provide tier layers.
14. The plant tray of any one of the preceding claims, further comprising flanges located on the side walls of the hollow body.
15. The plant tray of claim 14, further comprising grooves located on the underside of the flanges.
- 25 16. The plant tray of claim 14 or 15, wherein the flanges are provided with holes for accommodating securing means.