

DESCRIPTION

WALL-SURFACE-GREENING SYSTEM FOR BUILDINGS

TECHNICAL FIELD

[0001]

The present invention relates to a wall-surface-greening system for providing greenery on wall surfaces of structural objects.

The present application is based on patent applications No. 2006-043633, filed in Japan, February 21, 2006, and No. 2005-172204, filed in Japan, June 13, 2005, the content of which are incorporated herein by reference.

BACKGROUND ART

[0002]

Conventionally, green plants are planted on wall surfaces of constructions and civil structures (structural objects) for purposes of alleviating heat island phenomena in urban areas, absorbing carbon dioxide gas in atmosphere, and creating amenity spaces.

[0003]

A wall-surface-greening system of this type disclosed in, for example, by Japanese Unexamined Patent Application, First Publication No. 2004-248550 includes: a plurality of piped green plant units (green plant units) containing soil thereinside and green plants; a hanger member for supporting the green plant units horizontally with a predetermined vertical intervals; a wire joined to the uppermost green plant unit; and a hoisting apparatus, provided to a roof section of a construction, for hoisting the green plant units along a wall surface of the construction.

[0004]

Green plants can be provided in this wall-surface-greening system by covering wall surfaces of a construction with plants planted in green plant units arranged vertically. Also, in this wall-surface-greening system, a plurality of green plant units can be installed along the wall surface of the construction by successively joining green plant unit, i.e., by feeding a wire from the hoisting apparatus until reaching a ground section; attaching one of the green plant units to a lower end of the wire; winding the wire to some extent to elevate the green plant unit; and connecting another green plant unit to the elevated green plant unit with a hanger member. In contrast, a plurality of green plant units can be removed by successively detaching the lowermost one of the green plant units while successively feeding the wire. The green plant units can be installed or removed without using temporary scaffolds or a gondola.

[0005]

In addition, Japanese Unexamined Patent Application, First Publication No. 2002-95347 (Patent Document 2) discloses a wall-surface-greening system (green plant panel) that includes: a frame box including a plurality of rectangular boxes each having upper and lower lateral frame members, two-sided rigid frame members, and dividing frame member; and green plant plates each contained in each box in the frame box. In this wall-surface-greening system, the frame boxes are supported to the construction by attaching a plurality of blankets to the frame box and fixing each blanket to a wall surface of the construction with anchor bolts. Thus, the wall surface can be covered by green plants planted on a green plant plate in the box.

[0006]

Furthermore, for example, Japanese Unexamined Patent Application, First Publication No. 2002-34350 (Patent Document 3) discloses a wall-surface-greening

system including: a plurality of arm trees projecting from an outer wall of a construction; a plurality of frame members supported by the arm trees; a net attached to the frame member; and a plurality of planters placed on a ground around the construction along an outer periphery of the construction at the lower end of the frame. In this wall-surface-greening system, the plant planted in the soil in the planter is a deciduous bine plant, e.g., ivy that grows over the net or the frame members while being supported by the net or the frame members; thus, the wall surface of the construction can be covered by green plants.

[0007]

Furthermore, Japanese Unexamined Patent Application, First Publication No. 2004-150139 (Patent Document 4) discloses another example of a structure of tree-planting system for attempting placing green plants on wall surfaces and tilted roofs of constructions.

Patent Document 4 discloses a unit type green plant plate (hereinafter called green plant unit) having soil in frames. In this unit, rod steel frame members are assembled in a grid in which a plant, e.g., moss or sedum is planted.

DISCLOSURE OF THE INVENTION

Problems to be solved by the Invention

[0008]

However, the wall-surface-greening system disclosed by Patent Document 1 has a problem of low design freedom in view of aesthetic outlook attempting to plant greenery on an arbitrary position of the wall surface of the construction because green plant units should preferably be pended in vertical directions along the wall surfaces of the construction although the hoisting apparatus placed on the roof that feeds or winds the

wire facilitates installation or removal of the green plant units.

[0009]

Also, in the wall-surface-greening system disclosed by Patent Document 2 configured to include relatively rigid frame box formed to contain the green plant plates has a cost problem to plant greenery. In addition, this frame box fixed onto the wall surface of the construction by anchor bolts had problems in flexibility with respect to the maintenance of the construction or the wall-surface-greening system, e.g., re-painting the wall surface of the construction or exchanging green plant plates contained in boxes in the frame box.

[0010]

Furthermore, the wall-surface-greening system disclosed by Patent Document 3 places green plants, i.e., a bine plant growing from the planter placed on the ground over the net disposed upward and covering the wall surface of the construction. Therefore, this system has a problem in selectivity of plants for placing greenery similarly to the case of Patent Document 1, and in addition, has a problem of limited design freedom.

[0011]

The greenery system proposed by Patent Document 4 for placing the green plant units on the wall surface or on the tilted roof also has a defect of low design freedom for placing greenery because the green plant units fixed at predetermined positions on the frame member are difficult to be exchanged by another green plant unit, i.e., in a case where another kind of plant is preferred in, for example, buildings for commerce.

In addition, each green plant unit has significant weight because the frame is filled with soil. Therefore, components or material used for of the frame member must be rigid because the frame member supports the green plant unit on the wall surface or the tilted roof. Accordingly, material cost increases. Furthermore, arrangement for

pre-assembling the frame member onto an installation surface is time-consuming; thus, it takes cost.

Means for solving the Problems

[0012]

In consideration of the aforementioned circumstances, a first object of the present invention is to provide a wall-surface-greening system, having a superior design freedom and flexibility of maintenance, that can provide greenery to an arbitrary position of a wall surface of a structural object.

[0013]

In addition, a second object of the present invention is to provide a greening system for buildings having an improved installability with light weight structure and design freedom with respect to outlook of buildings having a green plant.

[0014]

The present invention provides the following means for achieving the first object.

A wall-surface-greening system according to the present invention for providing greenery to a structural object by disposing green plant units along a wall surface of the structural object is characterized in that, each green plant unit is provided with a soil plate and a plurality of frame members that hold the soil plate, the plurality of conduit members each having a substantial recessed shape in cross-section extends in a substantial horizontal direction while an opening section thereof is directed upward, the conduit members are disposed in a vertical direction with a predetermined interval onto the wall surface of the structural object, each frame member is supported by the conduit member detachably, and the green plant unit is installed between a pair of vertically adjoining conduit members.

[0015]

Also, in the wall-surface-greening system according to the present invention, it is preferable that an irrigation member for supplying water to the soil plate is provided between the soil plate and the conduit member disposed above the soil plate in the installed condition of the green plant unit.

[0016]

Furthermore, in the wall-surface-greening system according to the present invention, it is preferable that a lower end of the green plant unit is inserted into the conduit member disposed therebeneath via the opening section in the installed condition of the green plant unit.

[0017]

Also, in the wall-surface-greening system according to the present invention, it is further preferable that the frame member provided with a plurality of vertical members extending vertically and a plurality of lateral members extending horizontally is formed to be a grid-like basket, the green plant unit is formed by inserting the soil plate into the basket-like frame member and supporting the soil plate.

[0018]

Furthermore, in the wall-surface-greening system according to the present invention, it is more preferable that the soil plate is formed by mixing at least a foam member into heat fusion textile, heat-treating the mixture, and further solidifying the mixture.

[0019]

Also, in the wall-surface-greening system according to the present invention, the conduit member may be provided with a support member that projects to thereoutside from an outer surface, the green plant unit may be provided with a hook section formed by

projecting at least a part of the frame member upwardly relative to an upper end of the soil plate, and the green plant unit may be supported by the conduit member by hooking the hook section on the support member.

[0020]

Furthermore, in the wall-surface-greening system according to the present invention, the green plant unit may be provided with an unciformed hook section formed by projecting at least a part of the frame member upwardly relative to an upper end of the soil plate, and the green plant unit may be supported by the conduit member by hooking the unciformed hook section on the upper end that forms an opening section of the conduit member.

[0021]

In order to achieve the previously stated second object, a greening system for buildings according to the present invention includes a net member laid to cover an installation surface including a wall surface or a tilted roof of the building; and a soil plate made from a light weight material and carrying a plant, wherein a connection member unified to the soil plate is detachably connected to an arbitrary position on the net member.

In the present invention, disposition of the soil plate can be changed or a soil plate can be replaced by another one since a connection member that has been installed to a net member detachably can be detached from the net member.

[0022]

Also, in the greening system for buildings according to the present invention, it is preferable that the soil plate is made by a material including a foam member as a main ingredient.

In the present invention, the soil plate can be formed by, for example, mixing a heat fusion textile material into a inorganic foam member as a main ingredient,

heat-treating the mixture, and by solidifying the mixture. A three-dimensional net-like reinforcement structure imparted by adhesion between heat fusion textiles and by adhesion between textile and the inorganic foam member provides a light weight configuration and maintains the shape thereof. Therefore, the net member for supporting the soil plate made of such material can be of simple structure.

[0023]

Also, in the greening system according to the present invention, it is preferable that the connection member is embedded in the soil plate, and an extending section is formed by extending at least a part of the connection member out of a periphery of the soil plate and by fixing the extended part to the net member.

In the present invention, the soil plate can be attached to a layout range of the net member by fixing the extending section of the connection member to the net member.

[0024]

Also, in the greening system for buildings according to the present invention, it is preferable that the connection member is provided with a frame member that surrounds a periphery of the soil plate; and an engaging member that attaches the frame member to the net member.

In the present invention, the soil plate can be attached to a layout range of the net member by fixing the frame member to the net member via the engaging member.

Effects of the Invention

[0025]

In the wall-surface-greening system of the present invention, a plurality of conduit members each supporting a frame member detachably has a substantial recessed cross-section; the conduit member extends in a horizontal direction and is supported on a wall surface of a structural object; thus the conduit members are disposed at a

predetermined interval. Accordingly, a green plant unit can be installed at an arbitrary position of the extending conduit member, thus, design freedom associated with providing greenery on a wall surface of a structural object can be enhanced. Also detachable green plant unit can be maintained separately. Therefore, flexible maintenance can be conducted, i.e., the green plant unit can be easily removed for re-painting the wall surface of the structural object. Furthermore, since the green plant unit can be installed along the wall surface of the structural object, freedom of selectivity with respect to plants can be enhanced.

[0026]

Also cost for providing greenery can be reduced by a simple structure having the conduit member and the green plant unit.

[0027]

Furthermore, in the wall-surface-greening system of the present invention, the green plant unit is installed and supported by the conduit member by providing an irrigation member between the soil plate of the green plant unit and the conduit member positioned above this green plant unit. Simultaneously, water can be irrigated from its upper end to the soil plate of the green plant unit positioned therebeneath only by introducing the irrigation member including an irrigation tube having a lot of perforations into between the soil plate and the conduit member. Therefore, water can be supplied to the soil plate reliably, and the plant planted there can be grown desirably. Also, water being supplied from the irrigation member, having penetrated the soil plate but not absorbed there, and being drained from a lower end of the soil plate can be received by the conduit member that is positioned therebeneath and has an opening section. Therefore drainage can be carried out through the conduit member positioned therebeneath. Accordingly, the water supplied to the upper green plant unit can be prevented from being

supplied to the green plant unit positioned further below the lower conduit member, thus, excessive water supply to the lower green plant unit that retards the growing of the plant is prevented.

[0028]

Also, in the wall-surface-greening system of the present invention, the lower end of the green plant unit that is installed and supported by the conduit member is inserted into the conduit member positioned therebeneath. Accordingly, water irrigated to the soil plate of the green plant unit and drained from the lower end of the soil plate can be maintained by the lower conduit member and the lower end of the soil plate inserted through the conduit member; thus, frequency of irrigation can be reduced.

[0029]

Furthermore, in the wall-surface-greening system of the present invention, the soil plate can be held by the frame member reliably by, forming the frame member in a grid-like basket shape, inserting the soil plate into the frame member, and maintaining the soil plate there.

[0030]

Also, light weight soil plate can be obtained by forming the soil plate by, mixing a heat fusion textile into a foam member, heat-treating the mixture, and solidifying the mixture. Thus, the frame member for holding the soil plate can be simplified. Since this enables attempting light weight green plant unit, load applied to the structural object can be reduced, and simultaneously, installation and removal of the green plant unit can be facilitated; thus, installability and maintenance capability can be improved.

[0031]

Furthermore, in the wall-surface-greening system of the present invention, the support member is provided to the conduit member, and the hook section that can engage

to the support member and support the green plant unit is provided to the frame member of the green plant unit. Accordingly, the green plant unit can be installed by a simple operation of hooking the hook section on the support member; thus the green plant unit can be attached or detached easily. Also, the hook section may be a receiving section for fixing the green plant unit using a bolt-and-nut engagement.

[0032]

Also, since the hook section formed in an unciformed shape is provided to the frame member in the wall-surface-greening system of the present invention, the green plant unit can be installed by a simple operation of hooking the hook section on the upper end that defines the opening section of the conduit member; thus the green plant unit can be attached or detached easily.

According to the greening system for buildings of the present invention, disposition of the soil plate can be changed by freely changing the position of the soil plate in an extending range of the support member as a guide after the installation of the soil plate. Also, a soil plate 5 of a certain kind and having a certain color can be replaced by another soil plate of a certain different kind and having a certain different color. Therefore, design freedom associated with outlook of buildings can be enhanced.

Also, since the weight of the soil plate is not significant, it is possible to reduce the weight of the net member; thus, the structure thereof can be simplified, and material cost can be reduced. In addition, since installation task for the net member and the soil plate can be simplified, installation time can be shortened; thus, installation capability can be enhanced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033]

FIG. 1 illustrates a wall-surface-greening system according to a first embodiment according to the present invention.

FIG. 2 is a cross-section viewed along a line X-X in FIG. 1.

FIG. 3 is an enlarged view of the green plant unit in the wall-surface-greening system shown in FIG. 1.

FIG. 4 is a cross-section viewed along a line X-X in FIG. 3.

FIG. 5 illustrates a water-supplied condition of a conduit member in the wall-surface-greening system illustrated in FIG. 1.

FIG. 6 is a cross-section viewed along a line X-X in FIG. 5.

FIG. 7 shows green plant units arranged to cover an entire wall surface of the structural object in the wall-surface-greening system according to the first embodiment of the present invention.

FIG. 8 shows green plant units arranged in lines on a wall surface of a structural object in the wall-surface-greening system according to an embodiment of the present invention.

FIG. 9 shows green plant units arranged to indicate a certain letter on a wall surface of a structural object in the wall-surface-greening system according to an embodiment of the present invention.

FIG. 10 shows a modified example of a structure for supporting green plant units by conduit members of the wall-surface-greening system according to an embodiment of the present invention.

FIG. 11 is a cross-section viewed along a line X-X in FIG. 10.

FIG. 12 is an outlook of a greening system according to a second embodiment of the present invention.

FIG. 13A illustrates a structure of a front surface of a soil plate.

FIG. 13B illustrates a structure of a side surface of the soil plate.

FIG. 14A is a front view of the soil plate of the greening system according to a third embodiment of the present invention.

FIG. 14B is a plan view of the soil plate of the greening system according to the third embodiment of the present invention.

FIG. 14C is a side view of the soil plate of the greening system according to the third embodiment of the present invention.

FIG. 15 illustrates an engaging member for use in the soil plate illustrated in FIGS. 14A to 14C.

Explanation of Reference Numerals and Symbols

[0034]

- 1: conduit member
- 1a: opening section
- 1b: side wall section
- 1c: side wall section
- 1d: extending-directional double end section
- 1e: wall
- 1f: upper end
- 1g: upper end
- 2: green plant unit
- 2a: lower end
- 3: irrigation tube
- 4: support member
- 5: soil plate

- 5a: upper end
- 5b: front surface
- 6: frame member
- 6a: vertical member (frame member)
- 6b: lateral member
- 6c: surface
- 6d: a pair of vertical members
- 6e: hook section
- 8: engaging member
- 8a: engaging section
- 9: anchor member
- 10: hook section
- 11: fixture member
- 12: installation surface
- 13: net member
- 14: skeletal member (connection member)
- 14a: extending section
- 16: plants
- 17: frame member
- 17a: front surface
- 17b: back surface
- 17c: bottom surface
- 17d: double side surfaces
- 17e: upper surface
- 71: frame member

A: wall-surface-greening system

T: structural object

T1: wall surface

W: surplus water

BEST MODE FOR CARRYING OUT THE INVENTION

[0035]

Preferable embodiments for carrying out the present invention are explained in details with reference to drawings as follows.

[0036]

A wall-surface-greening system according to an embodiment of the present invention will be explained as follows with reference to FIGS. 1 to 9. The present embodiment relates to a wall-surface-greening system for providing greenery on inner or outer wall surfaces of a structural object including a construction or a civil structure.

[0037]

As illustrated in FIGS. 1 to 4, the main components constituting a wall-surface-greenery system A of the present embodiment are a plurality of conduit members 1, supported while being fixed on a wall surface T1 of a structural object T, and arranged vertically at a predetermined interval; a plurality of green plant units 2 each supported by the conduit member 1 and placed between each pair of adjoining vertically conduit members 1; and irrigation tubes (irrigation members) 3 placed between the conduit member 1 and the green plant unit 2.

[0038]

The conduit member 1 is a channel formed to have a substantial C-letter shape in cross-section. The conduit member 1 is fixed on the wall surface T1 by using, for

example, anchor bolts that secure a first side wall section 1b onto the wall surface T1 while an opening section 1a is directed upward; and the first side wall section 1b of a pair of side wall sections 1b and 1c facing each other undergoes surface contact with the wall surface T1 of the structural object T. Also, the conduit members 1 each extends horizontally so that the extending directions are parallel. Furthermore, in the present embodiment, provided on an outer surface of a second side wall section 1c facing the first side wall section 1b of the conduit member 1, i.e., the outer surface of the second side wall section 1c located outward relative to the wall surface T1 of the structural object T are a plurality of support members 4, e.g., screws projecting outwardly from this outer surface. [0039]

The green plant unit 2 includes at least a soil plate 5 having green plants thereon; and a frame member 6 that holds at least the soil plate 5. The soil plate 5 of the present embodiment is formed in a substantial square plate so that one side of the soil plate 5 according to the present invention is, for example 580 mm in length and so that the thickness of the soil plate 5 is shorter than the length of the side. The soil plate 5 is formed by a thermal treatment for solidifying a mixture of inorganic foam member (foam member) such as perlite, peat moss and/or Vermiculite, and heat fusion textile. In addition, the soil plate 5 has three-dimension net structure formed by adhesion of the heat fusion textiles or adhesion between textile and the foam member so that the solidified shape thereof can be maintained desirably. Therefore the outer periphery of the soil plate 5 does not have to be surrounded by additional frame members or bags that maintains the shape thereof. That is, the soil plate 5 of the green plant unit 2 installed onto the wall surface T1 of the structural object T can maintain the shape thereof in case of exposure to wind and rain. Also, since the weight per unit volume of the main ingredient of the soil plate 5, i.e., the inorganic foam member is 0.5 kg/liter or less, the light-weight soil plate 5

has water-retainability and water-drainage appropriate for growing the plants.

[0040]

Desirable plants planted in this soil plate 5 are not necessarily limited to, e.g., moss, sedum, or bine plants. Methods are various for planting and growing plants on the soil plate 5, e.g., seeds may be dispersed directly onto the soil plate 5; or pot-plants may be further planted into recesses formed on the soil plate 5.

[0041]

A frame member 6 is provided with a plurality of vertical members 6a made of stainless steel cord extending vertically; and a plurality of lateral members 6b extending horizontally while the vertical members 6a and the lateral member 6b assume grid-like manner. The frame member 6 is formed in a substantial basket-like U-shape in side view. Also, this basket-like frame member 6 is formed to have a substantial rectangular shape in plan view while looking the wall surface T1 installed onto the structural object T. The frame member 6 has a size that can hold four sets of substantial square soil plate 5 inserted therein without having significant gaps inside the basket shape. Two sets of two vertical members (a pair of vertical members) 6d positioned on both ends of the horizontal extending direction among the vertical members 6a, installed onto the wall surface T1 of the structural object T, constituting the surface 6c positioned outwardly, project upwardly relative to an upper end 5a of the inserted soil plate 5. In addition, the tips thereof in the projection directions are joined. The joined position projecting upwardly relative to the a pair of vertical members 6d in the present embodiment is a hook section 6e.

[0042]

In the green plant unit 2 configured to have four soil plates 5 and four frame members 6, two horizontally arranged soil plates 5 and two vertically arranged soil plate 5 are inserted into each soil plate 5 and held more stably by the frame member 6. Also,

hook sections 6e of the frame member 6 are hooked in pending state on support members 4 provided to the conduit member 1 of the green plant unit 2. That is, the hook sections 6e of the green plant unit 2 are detachably hooked on screws (support members 4) of the second side wall section 1c of the upwardly positioned conduit member 1. The wall surface T1 of the structural object T located between the upper conduit member 1 and the lower conduit member 1 is covered by the green plant unit 2 installed in this manner. Also, this state of the lower end 2a of the green plant unit 2 is inserted into the conduit member 1 located therebeneath via the opening section 1a. Accordingly, an upper end of the green plant unit 2 is supported by the upper conduit member 1, and a lower end 2a thereof is supported by the lower conduit member 1. Thus, the green plant unit 2 in stable condition covers the wall surface T1 of the structural object T. Also, in the present embodiment, a plurality of green plant units 2 arranged in vertical and horizontal directions along the wall surface T1 of the structural object T are installed to cover a predetermined area of the wall surface T1 of the structural object T.

[0043]

On the other hand, a irrigation tube 3 is a drop tube having a plurality of perforations at a predetermined interval for supplying water passing therethrough to the exterior. Also, this irrigation tube 3 is disposed horizontally and introduced between the upper end 5a of the soil plate 5 of the green plant unit 2 and the upper irrigation tube 3 supporting this green plant unit 2. Also, a water reservoir tank for storing running water or rain and a pump for supplying the water in the water reservoir to the irrigation tube are connected to the irrigation tube 3. It should be noted that the water supplied from the water reservoir to the irrigation tube 3 includes liquid compost mixed therein by adding liquid compost (liquid compost) into the water reservoir.

[0044]

A method for installing a wall-surface-greenery system A having the aforementioned configuration is explained next along with functions and effects of the wall-surface-greenery system A according to the present embodiment.

[0045]

Firstly, a plurality of conduit members 1 are installed onto the wall surface T1 of the structural object T, and subsequently green plant units 2 are installed at arbitrary positions of the conduit member 1 based on a plan designed for providing greenery onto the wall surface T1. The green plant units 2 are installed with this state of simple operations of hooking the hook section 6e of the frame member 6 on the support members 4 provided on the second side wall section 1c of the conduit member 1 based on installation position for the green plant unit 2. In addition, light-weight green plant unit 2 facilitates its installation since the main ingredient of the soil plate 5 of the green plant unit 2 is inorganic foam member; and the grid-like and basket-like frame member 6 for holding the soil plate 5 is made of steel cable. Subsequently, a plurality of green plant unit 2 are conveniently installed on the area based on the design in view of providing greenery on the wall surface T1, and further the irrigation tube 3 is installed. Also, this state of simple operation causes the irrigation tube 3 to be installed by introducing the irrigation tube 3 between the upper end 5a of the soil plate 5 of the green plant unit 2 and the upper conduit member 1 supporting this green plant unit 2. Having installed the irrigation tube 3 in this state completes the providing of greenery onto the wall surface of the structural object T.

[0046]

In the wall-surface-greenery system A that is installed in the aforementioned manner according to the present embodiment, water is supplied to plants planted on the soil plate 5 by driving the pump with a timer or by a manual operation and feeding the

water in the water reservoir including the liquid compost through the irrigation tube 3. The water and the liquid compost dripping from the perforations of the irrigation tube 3 are supplied from the upper end 5a of the soil plate 5 of the green plant unit 2 disposed therebeneath. The water supplied from the upper end 5a of the soil plate 5 in this manner is further supplied from the upper end 5a of the soil plate 5 to a lower end (lower end 2a of the green plant unit 2); thus surplus water that is not absorbed by the soil plate 5 is drained from the lower end 2a. Conventional wall-surface-greening systems had problems such as root rot or disease to the plant since surplus water drained from the upper green plant unit 2 is further supplied to a lower green plant unit 2 that has undergone irrigation; and the green plant unit 2 disposed therebeneath must have excessive water-supply amount or excessive compost in amount. Conversely, lowering irrigation frequency and water supply per irrigation for preventing such root rot or disease sometimes destroys the plant.

[0047]

To address this problem, since the lower end 2a of each green plant unit 2 according to the present embodiment is inserted into the lower conduit member 1 having a substantial recessing shape in cross-section, the surplus water, drained from the lower end 2a of the green plant unit 2 received by the conduit member 1, passes through this conduit member 1, and then drained from an opening part at an end section in the extending direction of the conduit member 1. This can prevent occurrence of root rot or disease caused by excessive irrigation since excessive water is not supplied to the green plant unit 2 disposed beneath the wall surface T1 of the structural object T.

[0048]

Also, as illustrated in, for example, FIGS. 5 and 6, a wall 1e extending from a bottom plate section of the conduit member 1 to upward provided at a extending-directional double end section 1d of the conduit member 1 for shutting a part of

its opening section causes the surplus water W drained from the lower end 2a of the green plant unit 2 to be stored in the conduit member 1 so that water level is limited by the height of the wall 1e. The surplus water W at excessive water level over the height range of the wall 1e drained from the lower end 2a of the green plant unit 2 is supposed to overflow from an upper end 1f of the wall 1e and is further drained to the outside thereof. Accordingly, the amount of the surplus water W corresponding to the height of the wall 1e is stored in the conduit member 1 of the wall-surface-greenery system A according to the present embodiment, and thus, the stored surplus water W can continuously be supplied to the green plant unit 2 having the lower end 2a inserted therethrough. Also, adjusting appropriately the height of the wall 1e prevents the surplus water W from being supplied to the green plant unit 2, since the quantity of the water stored in the conduit member 1 is determined by the height of the wall 1e. Therefore, the plants do not suffer from root rot or disease.

[0049]

Alternatively, the hook section 6e of the light-weight green plant unit 2 hooked on the support member 4 of the conduit member 1 can be removed easily similarly to the installation thereof in order to change design for providing greenery on the wall surface T1 of the structural object T in the wall-surface-greenery system A according to the present embodiment. Such design change can be conducted easily by re-arranging the green plant units 2 by hooking the hook section 6e on the support member 4 of the conduit member 1 disposed at the positions corresponding to the design change after removing the green plant units 2 or replacing plants from one to another. Similarly to the aforementioned case, repainting the wall surface T1 of the structural object T or replacing the green plant unit 2 having plants destroyed can be carried out by attaching or detaching all or some of the green plant units 2.

[0050]

That is, in the wall-surface-greenery system A according to the present embodiment, substantially all surface of the wall surface T1 of the structural object T can be covered by the green plant unit 2 as illustrated in FIG. 7 since the hook section 6e can be hooked on the support member 4 to install the green plant unit 2, and since the support members 4 are provided to the conduit member 1. Simultaneously, greenery having line design can be provided on the wall surface T1 by installing green plant unit 2 on every two vertical stages as illustrated in, for example, FIG. 8. Also, greenery in a letter-shape can be provided by installing the green plant units 2 as illustrated in, for example, FIG. 9. Therefore, the wall-surface-greenery system A according to the present embodiment can obtain high design freedom that permits flexible design change with respect to installation and disposition of greenery since the green plant units 2 can be disposed at arbitrary positions on the conduit member 1 easily.

[0051]

Therefore, the wall-surface-greenery system A according to the present embodiment enables enhancing installation capability and design freedom with respect to providing greenery since the green plant unit 2 can be easily attached to or detached from the arbitrary positions on the conduit member 1 installed on the wall surface T1 of the structural object T, and since the irrigation tube 3 used for irrigation to the disposed green plant unit 2 can be disposed easily. Also maintenance can be carried out easily to the structural object T or the wall-surface-greenery system A itself having been provided with greenery.

[0052]

Also, easy installation capability with respect to the green plant units 2 due to simple operation of hooking the hook section 6e on the support member 4 of this state of

conduit member 1 can provide arbitrary selection of the position for installing the green plant units 2. This reliably and simply provides high design freedom.

[0053]

Furthermore, in contrast to conventional greening system where bine plants growing on the ground cover the wall surface T1, plants used for providing greenery on the wall surface T1 in the present invention does not have to be limited to bine plants, and thus selectivity of plants used for providing greenery can be enhanced, since the green plant unit 2 can be disposed between a pair of vertically adjoining conduit members 1 by disposing the conduit member 1 vertically, and since green plant units 2 can be disposed in vertical and horizontal directions along the wall surface T1 of the structural object T.

[0054]

Also, rigid frame members used in conventional wall-surface-greening systems are not necessary to be provided, thus, cost for providing greenery on wall surfaces can be reduced, since the soil plate 5 can be hold reliably by the frame member 6, and since the configuration is simple in this manner where the green plant unit 2 is formed by a basket-like frame member 6 made of stainless steel cord and a light weight soil plate 5.

[0055]

Furthermore, the irrigation tube 3 provided between the soil plate 5 of the green plant unit 2 and the conduit member 1 allows water to be irrigated to the soil plate 5 from its upper end 5a reliably, thus the plants planted there can grow desirably. Also, the surplus water W not absorbed by the soil plate 5 and thus drained from the lower end 2a can be received by the conduit member 1. The wall 1e provided to the conduit member 1 allows the surplus water W stored there. Water drainage function and water absorption function imparted by providing the conduit member 1 can accordingly prevent suffocation of plants and reduce frequency of irrigation.

[0056]

The present invention is not limited to the previously explained embodiment associated with the wall-surface-greenery system A. The present invention can be modified appropriately within the scope that does not deviate from the spirit thereof. Although the conduit member 1 explained in the present embodiment is a channel, e.g., a C-type channel, the shape thereof in the present invention does not have to be limited specifically as long as it assumes a substantial recessed shape. For example, an arch-shaped cross-section may be used.

[0057]

In addition, the green plant unit 2 according to the present embodiment can be detachably supported by the conduit member 1 by providing the hook section 6e formed by connecting the tips of the a pair of vertical members 6d to the frame member 6 of the green plant unit 2; by providing the support member 4 including screws projecting from the second side wall section 1c of the conduit member 1; and by hooking and engaging the hook section 6e to this support member 4. Alternatively, the green plant unit 2 may be supported by the conduit member 1 by forming the hook section 10 in an unciformed form and by hooking the hook section 10 on the upper end 1g of the second side wall section 1c. In this case, the green plant unit 2 can be installed more conveniently than in a case where the hook section 6e according to the present embodiment is hooked on the support member 4. Simultaneously, the hook section 10 can be hooked on an arbitrary position of the second side wall section 1c of the conduit member 1 extending horizontally. Therefore design freedom can be enhanced further.

[0058]

Also, in addition, as illustrated in FIGS. 10 and 11, fixture members 11 may be installed onto the hooked hook sections 10 from thereoutside to sandwich and press the

second side wall section 1c positioned therebetween the hook sections 10. In this case, the green plant unit 2 can be installed more stably because the hook sections 10 can be fixed to the conduit member 1 strongly.

[0059]

A greening system for buildings according to the second embodiment of the present invention is explained as follows with reference to FIG. 12, FIGS. 13A, and FIG. 13B. The soil plate according to the first embodiment is supported by a conduit member fixed to a wall surface of a building. In contrast, a soil plate according to the second embodiment is supported by a net frame members fixed to a wall surface of a building. FIG. 12 is an outlook of a greening system according to a second embodiment of the present invention. FIG. 13A illustrates a structure of a front surface of a soil plate. FIG. 13B is a side view.

[0060]

As illustrated in FIG. 12, the greening system A according to the second embodiment is installed on a installation surface 12 such as a wall surface or a tilted roof of a building.

The greening system A as illustrated in FIG. 12 includes: a net member 13, having a net, laid on a installation surface 12 and covering the installation surface 12; a frame member 14 (connection member) formed by a light weight net, etc., detachably joining the net member 13 at arbitrary position; a soil plate 5 made of light weight material having the frame member 14 embedded therein; and a plant 16 planted on the soil plate 5.

In addition, a plurality of soil plates 5 are arranged in vertical and horizontal directions at arbitrary intervals in the second embodiment.

Desirable plants 16 planted in this soil plate 5 are ground-covering plants (bottom weed) including moss, sedum, or bine plants, etc.

[0061]

The net member 13 illustrated in FIG. 12 is a net formed by knitting a streak member made of a light weight polyethylene or nylon material into grid. In addition, desirable methods for laying the net member 13 on the installation surface 12 are various, e.g., pending it from above, or fixing it directly to the installation surface 12 by means of an anchor, etc. It should be noted that the size of the net member 13 illustrated in FIG. 12 is arbitrary, i.e., the net member 13 may be divided into several sections.

[0062]

The soil plate 5 as illustrated in FIG. 12 uses a material that is disclosed in, for example, Japanese Unexamined Patent Application, First Publication No. 2002-119130 made by mixing heat fusion textile into a inorganic foam member such as perlite, heat-treating the mixture, and solidifying the mixture.

Since the soil plate 5 solidified in this manner has obtained a three-dimensional net-like reinforcement structure imparted by adhesion between heat fusion textiles and by adhesion between textile and the inorganic foam member, the soil plate 5 does not have to be surrounded by a specific frame member or a bag to maintain its shape. Therefore, it is not scattered by affection due to wind, etc. Furthermore, since the weight per unit volume of the inorganic foam member of the soil plate 5, i.e., the inorganic foam member is 0.5 kg/liter or less, the light-weight soil plate 5 has appropriate water-retainability and water-drainage.

The soil plate 5 made by such material is formed in a substantial square box-like shape having a constant thickness as illustrated in FIG. 12, FIG. 13A, and FIG. 13B.

[0063]

As illustrated in FIGS. 13A and 13B, the connection member 14 embedded in the soil plate 5 has an outline that is much greater than that of the substantial square of the soil

plate 5. The frame member 14, disposed in parallel with the front surface 5b of the soil plate 5, consequently forms an extending section 14a extending to the outside relative to four sides of the soil plate 5.

[0064]

As illustrated in FIG. 12, 13A, and 13B, the extending section 14a of the frame member 14 is joined to the net member 13 by means of an engaging member such as a cord member or a fixture member (not shown in the drawings), e.g., a clip that is easily detached in the greening system A in this manner. Accordingly, greenery can be provided by disposing the soil plate 5 to the net member 13.

The detachable soil plate 5 facilitates removal of the installed soil plate 5 from the net member 13.

[0065]

The greening system for buildings according to the previously explained second embodiment can change disposition by arbitrarily changing the position of the soil plate 5 in a layout range of the net member 13. Also, since a soil plate 5 having a plant 16 of a certain kind having a certain color can be replaced by another soil plate 5 having another plant 16 of a certain different kind having a certain different color, the soil plate 5 can be removed from the net member 13 for maintenance. Therefore, design freedom associated with outlook of buildings can be enhanced.

Also, the light weight soil plate 5 used in the greening system for buildings according to the previously explained second embodiment can simplify the structure of the light weight net member 13; thus, material cost can be reduced. In addition, since installation work for the net member 13 and the soil plate 5 can be simplified, installation time can be shortened; thus, installation capability can be enhanced.

Also, the use of solidified soil eliminates bags or pallet frames for containing soil.

Accordingly, the structure of the greening system a can be simplified into a light weight configuration, thereby facilitating installation.

Furthermore, the greening system A that provides greenery in an arbitrary area of the installation surface 12 of a building by disposing a plant 16 can obtain temperature-reduction effect, thereby contributing to restrict urban heat-island phenomena.
[0066]

A third embodiment of the present invention is explained next based on FIGS. 14A to 14C and 15. Note that elements that are equivalent to that of the previously explained second embodiment will be assigned the same reference symbols and redundant explanations thereof will be omitted in each of the following embodiments. Instead, components different from the second embodiment are explained. FIGS. 14A to 14C illustrate a soil plate used in a greening system according to the third embodiment of the present invention. FIG. 14A is a front view. FIG. 14B is a plan view. FIG. 14C is a side view. FIG. 15 shows an engaging member used in the soil plate illustrated in FIG. 14A to 14C.

The third embodiment as illustrated in FIG. 14A relates to a greening system a that uses a frame member 17 (connection member) formed by a metal net instead of using the connection member 14 (see FIG. 12) as previously explained in the second embodiment.

[0067]

As illustrated in FIGS. 14A to 14C, a frame member 17 is a substantial unified net-like frame member that surrounds the soil plate 5. A front surface 17a, a back surface 17b, and a bottom surface 17c of the soil plate 5 are formed by knitting a cord material into grid. The soil plate 5 is placed between the front surface 17a and the back surface 17b in the frame member 17. Also, as illustrated in FIG. 14A, an engaging

member 8 (see FIG. 15) is provided on double side surfaces 17d, 17d, and on the upper surface 17e. The engaging member 8 connects the frame members 71, 71 (see FIGS. 14B and 14C) of the frame member. As illustrated in FIG. 15, the engaging member 8 is a thin plate having the engaging sections 8a, 8a both of which are formed in a curled shape. The engaging sections 8a, 8a are engaged to the frame members 71, 71.

Also, as illustrated in FIGS. 14B and 14C, a hook-shaped anchor member 9 is provided on the upper end of the back surface 17b of the frame member 17. The soil plate 5 can be fixed to the net member 13 by connecting the anchor member 9 to the net member 13 (see FIG. 12).

In addition, as illustrated in FIGS. 14A to 14C, a irrigation tube 3 provided to the upper end of the soil plate 5 can supply water to the soil plate 5.

As previously explained, since the soil plate 5 having the frame member 17 unified therearound can be disposed to the net member 13, effects similar to those of the second embodiment can be obtained in the third embodiment.

[0068]

The present invention is not limited to the previously explained second and third embodiments associated with the greenery system A according to the present invention. The present invention can be modified appropriately within the scope that does not deviate from the spirit thereof.

For example, the outline of the soil plate 5 in the second and third embodiments that has been a substantial square is not necessarily limited into this shape. For example, it may be a rectangle, polygon, or a circle.

The soil plate 5 according to the previously explained embodiments has been made by mixing heat fusion textile into a main ingredient, i.e., an inorganic foam member and by solidifying the mixture. The material is not limited to this ingredient. In

conclusion, any soil can be used as long as a solidified condition of soil is light in weight and is not necessary to be coated.

Also, the net member 13 in the second and third embodiments that is a net may be, for example, a light-weight metal net.

Also, while the extending section 14a of the connection member 14 according to the second embodiment has a shape expanding from the periphery of the soil plate 5, the extending section 14a may be formed to at least a part of the net member 13 so as to be fixed to the net member 13. For example, the extending section 14a may expand only upwardly relative to the soil plate 5.

Also, the shape of the anchor member 9 is not limited to a hook-shape as shown in the third embodiment. For example, the frame member 17 may be connected to the net member 13 by means of an engaging member such as a cord member.

Furthermore, the soil plate 5 according to the second embodiment may be provided with a irrigation tube 3 similarly to the third embodiment.

Industrial Applicability

[0069]

In the wall-surface-greening system of the present invention, a plurality of conduit member each supports a frame member detachably has a substantial recessed cross-section; the conduit member extends in a horizontal direction and is supported on a wall surface of a structural object; thus the conduit members are disposed at a predetermined interval. Accordingly, a green plant unit can be installed at an arbitrary position of the extending conduit member, thus, design freedom associated with providing greenery on a wall surface of a structural object can be enhanced. Also detachable green plant unit can separately be maintained. Therefore, flexible maintenance can be conducted, i.e., the green plant unit can be easily removed for re-painting the wall surface

of the structural object. Furthermore, since the green plant unit can be installed along the wall surface of the structural object, freedom of selectivity with respect to plants can be enhanced.

Also, according to the greening system for buildings of the present invention, disposition of the soil plate can be changed by freely changing the position of the soil plate in an extending range of the support member as a guide after the installation of the soil plate. Also, a soil plate 5 of a certain kind and having a certain color can be replaced by another soil plate 5 of a certain different kind and having a certain different color. Therefore, design freedom associated with outlook of buildings can be enhanced.

Also the light weight soil plate can facilitate the light weight structure of the net member; thus, material cost can be reduced. In addition, since installation task for the net member and the soil plate can be simplified, installation time can be shortened; thus, installation capability can be enhanced.

Claims:

1. A wall-surface-greening system for providing greenery to a structural object by disposing green plant units along a wall surface of the structural object, each green plant unit being provided with a soil plate and a plurality of frame members that hold the soil plate, wherein the plurality of conduit members each having a substantial recessed shape in cross-section extends in a substantial horizontal direction while an opening section thereof is directed upward, the conduit members are disposed in a vertical direction with a predetermined interval onto the wall surface of the structural object, each frame member is supported by the conduit member detachably, and the green plant unit is installed between a pair of vertically adjoining conduit members.
2. The wall-surface-greening system according to Claim 1, wherein a irrigation member for supplying water to the soil plate is provided between the soil plate and the conduit member disposed above the soil plate in the installed condition of the green plant unit.
3. The wall-surface-greening system according to Claim 1 or 2, wherein a lower end of the green plant unit is inserted into the conduit member disposed therebeneath via the opening section in the installed condition of the green plant unit.
4. The wall-surface-greening system according to one of Claims 1 to 3, wherein the frame member provided with a plurality of vertical members extending vertically and a plurality of lateral members extending horizontally, the frame member is formed to be a grid-like basket, the green plant unit is formed by inserting the soil plate into the

basket-like frame member and supporting the soil plate.

5. The wall-surface-greening system according to one of Claims 1 to 4, wherein the soil plate is formed by mixing at least a foam member into heat fusion textile, heat-treating the mixture, and further solidifying the mixture.

6. The wall-surface-greening system according to one of Claims 1 to 5, wherein the conduit member is provided with a support member that projects to thereoutside from an outer surface, the green plant unit is provided with a hook section formed by projecting at least a part of the frame member upwardly relative to an upper end of the soil plate, and the green plant unit is supported by the conduit member by hooking the hook section on the support member.

7. The wall-surface-greening system according to one of Claims 1 to 5, wherein the green plant unit is provided with an unciformed hook section formed by projecting at least a part of the frame member upwardly relative to an upper end of the soil plate, and the green plant unit is supported by the conduit member by hooking the unciformed hook section on the upper end that forms an opening section of the conduit member.