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VERTICAL GARDEN

WERTYKALNY OGRÓD

Abstract

The constant expansion and intensification of urbanized areas resulting in microclimate deterioration, high air pollution and dust pollution levels, as well as noise provoking a response and a rise in urban greenery, is currently observed. In this context, the subject of green walls also known as vertical gardens subscribes to the notion of sustainable design and its growing popularity manifests the unbreakable bond between man and nature. One cannot overestimate the importance of green wall technology, which provides architects with new ecological elevation material, offering an unlimited number of textures and colour effects, changing according to the time of the day and season, and sometimes unpredictable even for the designer himself.

Keywords: vertical garden, green wall, façade, sustainable design, nature, human-being

Streszczenie

Nieustanna ekspansja i intensyfikacja terenów zurbanizowanych, powodująca pogorszenie mikroklimatu, wysoki poziom zanieczyszczenia i zapylenia powietrza oraz hałas wywołały reakcję i obecnie obserwuje się wzrost znaczenia zieleni w mieście. Rozpatrywane w tym kontekście zagadnienie zielonych ścian- tak zwanych wertykalnych ogrodów wpisuje się w nurt projektowania zrównoważonego, a jego rosnąca popularność jest manifestacją nierozerwalnego związku człowieka z naturą. Znaczenie technologii zielonych ścian, która daje do dyspozycji architektowi nowy, ekologiczny materiał elewacyjny, oferujący nieograniczoną liczbę faktur i efektów kolorystycznych, zmieniających się w porze dnia i roku, czasami niemożliwych do przewidzenia dla samego projektanta, jest nie do przecenienia.

Słowa kluczowe: wertykalny ogród, zielona ściana, elewacja, zrównoważony rozwój, natura, człowiek

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1. Introduction

The constant expansion and intensification of urbanized areas, resulting in microclimate deterioration, high air pollution and dust pollution levels, as well as noise provoking a response and a rise in urban greenery, is currently observed. This is confirmed by the fact that one of the most promoted and dynamically developing trends in designing is sustainable design. Such words as 'Eco' or 'Green' became the intrinsic elements of colloquial language. Increasingly, we are also finding green walls in architecture. The question arises as to whether the green wall technology, also known as 'vertical gardens' in context of its energy intensity, complexity of creating, maintaining and usage of non-biodegradable building materials, has an actual beneficial influence on the environment or it only looks green.

2. Constructing a vertical garden

The vertical garden benefits from the fact that in order to survive, plants need light, carbon dioxide, suitable temperature, water and minerals. Contrary to general beliefs, plants can vegetate without soil. This observation allowed French botanist Patrick Blanc to start creating and patented his first green walls called vertical gardens. They were inspired with tropical landscapes where plants, which have optimal conditions of habitat, grow directly on rocks [1]. The broader view on the genesis of the idea of a vertical gardens' creation, is provided by W. Kosiński referring to cultural examples. Inter alia refers to Babylon Gardens, traditional gardening art related to residential architecture and pitched roofs covered with grass of regional Scandinavian architecture [4]. The term of vertical garden covers inter alia systems providing the opportunity for plants to grow in properly shaped wall layers made on the construction site; modular systems prefabricated, delivered and combined at the investment spot, building walls, support installations made of iron nets, bars or ties and acoustic screens covered with creepers creating green vertical surfaces ingrained in the soil.

In order to maintain a vertical garden on an artificial wall in the city and at the same time to ensure the security of the building, it is necessary to make a supporting construction and plan watering and nutrition systems.

The vertical garden authored by Patrick Blanc in cross section consists of three parts: a supporting construction, waterproof layer which protects the building wall from water and a vegetation layer where plants take root. The watering system is placed between layers of felt. Each of the layers can be formed into any shape. The supporting construction usually takes the form of a light metal frame, which is hung on a free standing wall or an already existing wall of a building. The waterproof layer is a standard 1 cm thick PCV sheet; this layer not only protects against water, but it also brings stiffness to the whole structure. As the substrate, on which plants can take root, a thick felt layer is used. The felt made from polyamide is resistant to biodegradation and it also provides retention and distribution of water and microelements. The watering system should provide continuous water circulation. The watering process begins from the top of the wall. Then water is supplied successively to the roots of plants planted below. Unused water flows down on the felt layer and is collected on the bottom and pumped to the top to be re-used. Many watering systems can

be programmed automatically which makes the system more efficient and the mixture of nutrients can be adjusted in accordance with plants' needs in a given part of the day[1, 10].

The choice of plant species is strictly dependent on climate conditions and exposure of the wall. The height of a building is also significant. The higher plants are installed, the greater their resistance to extreme temperature, wind and sunlight should be. The plants should be light, their root system must be spreading and not of the pile form. It is also important to choose evergreen plants, so that a vertical garden will fulfill its role throughout the whole year [2]. An additional guideline for shaping the vertical garden is the functional aspect. In order to provide a wide passage round the building it is recommended to situate smaller plants on the lower part of the wall and shrubby ones higher up [1]. Life expectancy is an important factor while calculating the cost of green wall exploitation. It is recommended to choose mosses, ornamental grasses, perennials, shrubs which live a few to dozens of years with a high tolerance to environmental pollution. Aging and withered plants should be replaced during a garden maintaining process of minimum every half year.

All mentioned above materials that are used to construct a vertical garden are non-biodegradable, it means that they are not subjected to decomposition influenced by biological factors. This is necessary because of providing fire security and durability of the construction.

3. Functioning of the vertical garden in a city

The popularity of the vertical garden has begun together with the success of Patrick Blanc, achieved during the International Garden Festival in Chaumont-sur-Loire in 1994. The presented structure in the form of a wall covered with plants attracted the interest of artists, followed by architects and landscape architects, which finally resulted in cooperation. They started to consider the possibility of application of vertical gardens in cities and inside buildings. The project carried out with Jean Nouvel or Jacques Herzog and Pierre de Meuron, bound permanently Blanc's activity with architecture [1]. Looking at such works like: Musee Du Quai Branly in Paris (2005) or Caixa Forum Museum in Madrid (2006), the saying of Frank Lloyd Wright that "a doctor can bury his mistakes, but an architect can only advise his clients to plant vines" [8] seems to be no longer valid.

Nowadays, plants are becoming a rightful façade material creating the architecture; their usage is planned and dedicated to achieve both a particular aesthetic and ecological effect. Urban landscape enriched with the vertical garden gains an additional biologically active surface, which increases its biodiversity. One can say that plants become a part of a building, but at the same time the building becomes a part of the ecosystem. An important feature of the vertical garden, especially significant for urban areas, is its ability to grow in already built up places, where there is no room for traditionally shaped greenery. The process of densifying building area concerns all agglomerations. Systems of public greenery designed mostly at the turn of the nineteenth century (inspired by such ideas as City Beautiful Movement and Garden Cities) and in the mid-twentieth century appear to be insufficient to serve twenty-first century cities. Thanks to vertical gardens it is possible to fix the systems of urban greenery made of traditional elements such as: alleys of trees, hedge, square, park, urban garden, green roof, which have to be continuous in order to work properly. The establishing cost and energy intensity of vertical gardens are relatively high and their maintenance is complicated in the

case of walls that exceeds 3m high; if coupled with an urban greenery system, they give such benefits as improvement of the city ventilation system, reduction of the heat island and increase the biodiversity.

The research on the potential influence of vertical gardens on air quality were conducted in Great Britain while creating the green wall near the Edgware Road underground station. Earlier studies showed that air pollution is deposited more easily onto plants than hard surfaces. Tom Pugh and his colleagues at Lancaster University created a model showing that green walls are particularly effective in the process of reducing such pollution as NO_2 and particulate matter PM_{10}, in streets where both sides are lined continuously with buildings and where the air circulation is limited. In such cases the pollution may be deposited on the green walls for a longer time. According to research, it is possible to reduce air pollution to as much as 40% for nitrogen dioxide and 60% for PM_{10} dust. The results of the analysis may vary depending on the street's layout, wind speed and the degree of wall covering with plants. Linda Davies presents a more careful approach to the above-mentioned results pointing out that the research was not tested in practice. Davies investigating the effect of green walls has selected plants with small hairy leaves which are best at absorbing PM_{10} [5, 6].

The building of the Foundation for Polish science in Warsaw, designed by FAAB studio is an example of implementation of a green wall in polish environment. It has been refurbished and adapted to a new function. It has also been designed and constructed in accordance to ecological standards. The building is equipped with heat pumps, rainwater tank and a 260 m^2 green wall double facade situated to the north and south. According to the designers idea, the green facade is supposed to aid air-conditioning systems. To protect plants from extreme temperatures which are typical for Poland and to prevent roots from freezing and falling off, a thicker layer of insulating material has been introduced for the plant roots. 20 species of plants have been selected for the design, however the authors point out that the form of the wall will change in time. The species will have to be tested in situ. Some of them may not be suitable for the polish climate and therefore, they will have to be replaced. The increase in biodiversity is inevitable due to seeds being transferred by the wind and birds. The green wall has an automatic irrigation system installed [7, 9].

The project was completed in 2013, so the evaluation of the designers' ideas is not yet available. Several questions arise such as: Is the energy gain which comes from the introduction of a double facade enough to compensate the use of water and electricity that is necessary for the irrigation system?

4. Conclusions

Much research shows that vertical gardens confirm their great usefulness in a city and have big and positive environmental effect. Systematic introduction of vertical gardens into cities seems to be justified and is the right solution for implementing greenery in places where it is necessary because of the low quality of the environment and difficulty of current land use. S. Herrington says that: '(...) landscapes are spaces that condition and are conditioned by cultural and natural systems directly connected to our well-being' [3]. It means that the spread of vertical gardens and green roofs in urban areas is an indication of the concern of humans about ecology, as well as the high quality of the cultural landscape.

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