Living wall (vertical greening): Benefits and Threats

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Abstract. Sustainable development demands a significant approach between architecture and the environment. During the challenge of climate change, energy crisis and urban expansion, a new approach is required to address environmental problems and one of these approaches is vertical greening that can be categorized into green facade and living wall.

Living wall systems (LWS) consist of plants and partly growing materials that have a number of beneficial functions, for example: increasing the outdoor and indoor comfort, ecological value, biodiversity, insulation properties, improvement of air quality mitigation of the urban heat island phenomenon, and psychological and social well-being of citizens. This paper focuses on different types of living wall systems as a method of sustainable development and their opportunities and threats were discussed.

Introduction

Vertical greening, which is the result of integration of vegetation and building, improve the ecological and environmental efficiency with positive influence not only on social and aesthetical value but also on well-being in and around the buildings. Since 2000 years ago in traditional architecture, climbing plants have been planted at the base of the buildings façades or planter boxes have been manipulated on the main elevations.

They may be utilized as a remarkable outdoor system, or may be applied indoor (by the help of natural or artificial lighting) in different climatic environments. The selection of plants and soils will be different according region and microclimate. Selected plants root in the ground, in modular panels attached to the façade or in the wall material itself, with the purpose of covering the buildings with plant foliage. Nowadays there are several different systems for vertical greening (green walls) that can be categorized into green façade (direct and indirect system) and living wall (passive, active, Mur-Vegetal and landscape wall) according to their systems and growing methods [1], [2]. This article will discuss different aspect of living walls.

Living wall

Living wall system (LWS) is built of modular panels. Each part holds its own soil or artificial growing medium, for example, perlite, felt, foam, and mineral wool. If the wall is to be a primarily self-sustaining ecosystem, it should be much easier to use soil as a planting medium. It is based on hydroponic culture, using balanced nutrient solutions to provide plant’s food and water requirements, although hydroponic chemical plant nutrients may destroy or disrupt the non-hydroponic component of the vertical green areas.

From a functional viewpoint in a comparison to green façade most of these systems need more complex design, as a greater number of variables must be considered, there are more supporting materials, several layers are involved, and mechanism of water and nutrient should be conducted. From an economic point of view they are more energy consuming and difficult to maintain (e.g.
supply nutrient to fertilize the plants) and therefore very expensive [3]. These systems increase the variety of plants engaged mostly evergreen plants as ferns, low shrub, perennial flowers and even edible plants. They do not make use exclusively of climbing plants; therefore they offer much more aesthetic and creativity. Selecting the plant species for operative green wall is a complicated procedure. It is vital to select the plants that are modified conveniently to the environment where they will be living in. The durability of living wall systems is important to take into account and varies according to the type of system. Living wall systems with panels based on felt layers have an average life expectancy of 10 years, and living wall systems based on planter boxes last more than 50 years[3], [4]. Fig. 1 illustrates different kinds of living walls.

![Fig. 1 (left), Living wall based on: (a) planter boxes, (b) foam substrate, (c) felt layers, (Source: [4])](image1)

**Passive living wall**

Passive living wall emerged from the usage of green roof applications, with a number of technological innovations. It is mostly applied in modular systems which are made up of rectangular or square panels which contain a growing media and keep plant material. As modular systems are usually pre-grown, providing an immediate green effect upon completion of the installation is possible (Fig. 2). The necessity nutrient requirements are prepared in the growing media. Irrigation which applies gravity to transfer water through the growing media is supplied with this equipment along the wall at different heights. A waterproof substance insulates the system from the building wall in order to prevent wetting problems, furthermore emitters, fertilizers, irrigation and lighting systems may be required [5]. Fig. 3 illustrates living walls’ usual components.

![Fig. 2 (right), Passive living wall, (Source: La societe Green wall)](image2)

![Fig. 3 (left), Living walls components: 1.Panels, 2.Non-soil structural growth medium, 3.Plants, 4.Remote irrigation/fertilization system, 5.Stainless steel frame, (Source: Gsky.com)](image3)

![Fig. 4 (right), Active living wall, (Source: GM Canada and air quality solution)](image4)
Active living walls

Active living walls apply a forced air flow through the subs-tract which considerably improves the passive living wall advantages. It is intended to be integrated into a building’s infrastructure and designed to act as bio-filters indoor air and ecological air conditioning systems.

This hydroponic system is fed by rich nutrient water that is recirculated from a manifold. In order to support dense plant roots mass, two layers of synthetic fabric sandwich them. The plants’ natural process absorbs carbon monoxide and produces cool fresh air by a fan that pulls environment air through the system and distribute it throughout the space. Therefore when these systems are integrated with the building’s air conditioning installations, reductions in energy consumption can be obtained up to 30% and there is potential to apply these systems on a large scale [5] (Fig. 4).

Mur-Vegetal and Landscape wall

The Mur-Vegetal is an exclusive type pioneered by Patrick Blanc who is a French botanist specialized in plants from tropical forests and well known as the contemporary innovator of green wall [6]. This system consists of two layers of synthetic fabric with several pockets that physically keep growing media and support plants. Because of fabric wall’s high moisture content, it is held by a frame and supported by a waterproof substance against the building’s main wall. The irrigation system that propels, water from top to down, also distribute nutrients to the plants roots (Fig. 5).

Fig. 5 (left), Mur Vegetal (Source: http://flickr.com/photos)
Fig. 6 (right), Landscape wall, (Source: http://www.herculesmfg.com)

Landscape wall is an evolution of landscape berms. They are normally sloped against the vertical barrier and have the major functions of slope stabilization and noise reduction. They also play a strategic role in an approach to green architecture. They are constructed from some stacking material made of concrete or plastic with spaces for plants and growing media [5] (Fig. 6).

Benefits and threats

The benefits concern several fields, and operate on a different scale. Some work if merely a vast surface in the same area is covered with vegetation, so their benefits are only noticeable at a neighbourhood or city scale. The others work exactly at the building scale. Relevant aspects that have influence on these benefits are the thickness of the foliage, material properties, water content and probable air cavities among different layers [3].

Environmental benefits include photosynthesis, pollution filtration, requisition carbon dioxide, decrease in fine dust levels [1] and cleansing of the air. Furthermore, sound reduction is potential by the use of vegetation. Three factors that influence capability of noise reduction are: depth of the growing media, overall coverage and the materials applied as structures and components of the living wall. Aesthetic enhancement is the first priority of the most living wall design objective (Fig. 7). Urban streets with boring facades, large parking structures, public park walls, campus buildings, retail buildings, transit shelters, all are opportunities for the building envelope to change visually and implementing qualities of natural design contribute to aesthetic enhancement [4].
On the other hand vertical greening systems can be very expensive to install and maintain. From all the vertical greening systems the living wall system is the most expensive system because of the panels and plant species, irrigation and installation cost. Maintenance costs depend on the type of the living wall system and not only water pipes substitution, plant species substitution and pruning costs, but also panels' replacement has to be added to the maintenance costs. In addition, there are some other costs: greening system's disposal (removal of plants and structures, transport to landfill, and dump), taxes and the plaster (cladding) renewal [7] therefore in order to enhance dense cities’ environmental conditions, it is essential to minimize the economic impact and enable a wide use of greening systems.

Conclusion

Contemporary technologies offer a wide range of options for Eco-Architects to incorporate greenery to the interior and exterior of buildings. Vertical greening is a key component of sustainable development. These systems will become significant fixtures in urban areas in the next few years.

References


