Scientific Papers. Series B, Horticulture. Vol. LIX, 2015
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

GREEN ROOF VEGETATION POSSIBILITIES

Zuzana POÓROVÁ, Zuzana VRANAYOVÁ

Technical University of Košice, Civil Engineering Faculty, Vysokoškolská 4 Košice 042 00, Slovakia, Email: zuzana.poorova@tuke.sk, zuzana.vranayova@tuke.sk

Corresponding author email: zuzana.poorova@tuke.sk

Abstract

The aim of this article is showing few ways how to make green roofs. The difference between intensive and extensive green roof, plant establishment and choice of plants is described. Aim of this article is showing the best combination of designed roof construction, designed thickness of soil and designed vegetation. Types of soil, depending on intensive or extensive green roof are described. Types of vegetation, depending on intensive or extensive green roof are described.

Key words*: establishment, green roof, medium, plant*.

INTRODUCTION

In just few years, green roofs have gone from a historical curiosity to a booming growth industry – primarily because the environmental benefits of extensively planted roofs are now beyond dispute, whether for industrial or governmental complexes or private homes in urban or suburban settings. This paper deals with extensive green roofs. Nature helping the body, views offered for people living near green roofs, relaxant attributes of wildness in built environment. In bigger detail it focuses on its plants and vegetation, its construction, attributes and best use and choice of plants.

Medium depth and its greater depth means more diversity of used plants because of more options for growing roots of used plants. Composition of the underlying medium influences load of soil. This also means influencing plant specification in terms of weight, water absorption capacity, drainage rates etc. The ideal medium is lightweight, retaining water well, also porous and freely draining. The more water the medium retains, the more weight is being added to the roof. The medium supplies and absorbs nutrients, anchors the plants, provides enough weight to avoid floating when wet and avoids being flown off during establishment (Dunett, 2004).

Extensive green roofs are lightweight veneer systems of thin soil or substrate layers of drought tolerant self-seeding vegetated roof covers. Extensive green roofs require special types of plants. Also, they can be constructed on existing structures with little, or no additional structural support.

Generally, extensive green roof medium is a blend of sandy or granular materials that balances water absorption with adequate porous surface. A variety of natural and unnatural materials can be used to achieve balance. Lelite, pumice, diatomaceous earth, sand, expanded and active clays, expanded shale, gravel, bricks and tiles. And vermiculite or perlit can be used in conjunction with other materials (Snodgrass, 2006). But we need to face the fact that using these kinds of materials the green roof is going to be less environmental and more expensive than purely natural medium.

Intensive green roofs are designed to look like gardens, landscapes. They need similar management as ground gardens. Contemporary technological conditions allow many things. Waterproof membranes help to capture water for irrigation, drainage support growing medium and resist invasion of roots of plants. During the day, temperature of asphalt roof is unbelievably high. On green roof, soil mixture and vegetation act like an insulation. Reducing heating; cooling the building. When it is raining, water floods down to city´s artificial canyons. A living roof absorbs water, filters it and slows it down.

More organic medium, more planting options are available. Predominantly organic medium is not recommended for extensive green roofs.

Because of decreasing of pore space, higher water retention and increasing nutrient loading, reducing medium depth over time may be caused. Changing of medium depth may cause change of the designed roof, adding the substrate and changing environment of planted vegetation. Depth of medium should be constant over a long period of time and highly organic medium makes it impossible.

MATERIALS AND METHODS

Plant establishment is the key to green roof´s longevity. If the establishment in the beginning is unsuccessful, time of the return of investments is going to be lengthened. It is very important and also much cheaper to ensure the plant establishment in the beginning or even before the realization of the roof. First weeks after installation are crucial. It is prudent to plant the plants early enough to allow plants to root in before the first frost. Trials performed at Penn State University on plant establishment showed that well-established plants were much more likely to survive winter and drought than plants that were poorly established (Thuring, 2014).

Proper care during establishment will provide achieving coverage in earlier date. Planting occurs regular irrigation. If planting occurs in areas with natural rainfall that is regular, irrigation may not be needed. On many installations on US East Coast, plants require no supplemental irrigation at all, not even upon planting. On the other hand, parts in North require care and every day irrigation. Irrigation can be achieved through several methods: built in irrigation systems, lawns sprinklers, garden hoses. Irrigation need should be ascertained and used for the specific plants, location and time of year when the roof is being installed (Snodgrass, 2006).

Seeds are first way of installing green roof. No wholly seeded green roof installations exist in North America, but it seems likely that they will eventually appear. Market pressures to decrease installation costs by direct sowing on green roofs that could become more viable and the least expensive method (Snodgrass, 2006).

Seeded green roof takes the most time to mature, generally two to three years for coverage. Limited numbers of species can reliably germinate on a roof. All require some supplementary irrigation during germination and establishment phase. Seeds are best sown in spring or fall, depending on climate. To achieve full coverage of a roof in a short time period, quicker maturing annuals could be mixed with perennial seeds.

Cuttings are the most used plants installed on green roofs. They are viable and increasingly popular method for establishing. They are quicker than seeds and depending on climate, place and time, they may not need any supplementary irrigation to help them to establish. Cuttings are more expansive than seeds, but they achieve coverage much earlier. They can cover the roof within a year after planting (Nakano et al. 2014).

Plugs are cuttings with established root system. They offer a compromise between cost and flexibility. They offer greater diversity, because fully rooted plugs store sufficient energy to allow for easy establishment. They are easily packed in boxes (Nakano et al. 2014).

Nursery containers are occasionally specified for extensive green roofs when more established plants are needed from the beginning. Where the medium is deep enough to accommodate the root system, vegetation will spread more quickly than of plugs. If the depth of the root ball is bigger than depth of soil, root ball needs to be broken, roots need to be shortened to fit into soil (Nakano et al. 2014).

Vegetative mats are long rolls of pregrown plants set in a thin layer of mesh and medium. They are fully mature upon installation. They are installed in strips on top of a base substrate, which provides eventual root support. Mats are heavy and bulky to transport, must be grown at least one year before installation (Snodgrass, 2006).

Modules are discrete vegetative systems of black plastic squares or rectangles. They are the most expensive green roof planting option. They share all advantages and disadvantages of mats, but they include more medium. They can be installed like pavers (Snodgrass, 2006).

RESULTS AND DISCUSSIONS

The most influential parameter on vegetation layer is the leaf area index (LAI) that depends

basically on the foliage density, the foliage geometric characteristics and on the plant height. Thus, the most important contribution of the vegetation layer to the thermal behaviour is shadow effect, both by the interception of solar radiation and reduction of roof surface temperatures (Theodosiou, 2003). Vegetation cover (LAI) and consequently the ability to produce shade can become reduced in certain periods of the life of the extensive green roof, for example during the plant growth period, which can last up to two years, or in water shortage periods, disease, or even because the type of plants, etc. Also it is known that because the type of plants and the low maintenance levels, extensive green roofs hardly reach 100% of the vegetation cover.

Figure 1: Sempervivium

Hardy succulents are the workhorses of extensive roofs and the primary plants for systems using a medium of 10, or less centimetres. Plants are native from dry locations, semi-dry locations, stony surfaces such as alpine environment. These kinds of plants have typical mechanisms to survive extreme conditions. Mechanisms like water storage organs, thick leaves, thick leaves surfaces, narrow leaves etc. They have unsurpassed ability to survive drought and wind conditions, store water in their leaves for extended periods and conserve water through a unique metabolic process. Hardly succulents like Sempervivum Fig. 1, Sedum, Talinum, Jovibarba, Delosperma are the only choices for thin substrate, non-irrigated, extensive green gardens with the greatest survivability (Snodgrass, 2006).

Figure 2: Phacelia Campanularia

Annuals should not be the dominant plant selection for extensive green roof, because they do not offer longevity required to make a project cost effective. They can be used as seasonal accents. They are required in places with regular rainfall, or in places with irrigation system. Annuals like Phacelia Campanularia Fig. 2, Portucala, Townsedia Eximia may be used on extensive green roofs as filters to provide quick colour during first grown season (Snodgrass, 2006).

Figure 3: Dianthus Dianthus Prairie Pink

Herbaceous perennials are the most desired plants for aesthetic reasons. They offer great colors, textures and season variability. On the other hand, they require deeper substrate and moisture than are found on most extensive green roofs. Some of them work very well on extensive roof installations. Dianthus Fig. 3, Phlox, Campanula Garganica, Teucreum, Allium, Potentilla, Achillea, Prunella, Viola, Origanum and some other low growing and shallow rooted perennials can be used, however, medium depth must be greater than 10 cm and has to have adequate water source. Few herbaceous perennials are evergreen, so if winter interest is a major design consideration for a roof, alternative must be provided so the brown vegetation is not so visible during its dormant period (Snodgrass, 2006).

Figure 4: Carex

Figure 5: Salvia

Short grasses are mostly popular for traditional intense green roofs and landscaping, but they still have their place in extensive green roofs. They do not have colorful bloomers like annuals and perennials, but they do have a lot of offer. They are more vertical, they add a texture and motion into a picture of roof, offer birds, insects habitat. They do need deeper depth of soil to accommodate their root system, some of them may have a Durant period during summer what means having a brown spot on the roof some time. Short grasses like Carex Fig.4, Festuca, Deschampsia are appropriate for extensive roofs.

Herbs as Thymus, Origanum, Salvia Fig. 5 and Allium have mostly their selected use on green roofs because of depth of soil that has to be more than 10 centimetres. On the other hand, their use is very specific because of their aroma, what is commonly used on buildings like restaurants, hospitals, residences, institutional buildings, they can be harvested for culinary, aromatic, therapeutic or educational purposes (Snodgrass, 2006).

CONCLUSIONS

Groundcovers like hardly succulents should be predominant plants used on extensive green roofs with a limited amount of accent plants. Groundcovers provide a rapid, reliable and cost-effective spread over the roof.

Accent plants like annuals, perennials, herbs and grasses while spectacularly during bloom, may not live more than five years on the roof.

In addition, they do not spread as rapidly as groundcovers, more plants are required to cover an area, but they offer seasonal interest. They may be replenished by periodic re-sowing.

Combination of these types of plants is the best way to come to this state. These combinations offer solution to make roof green all year long but with some colourful spots according to designed and used plants.

ACKNOWLEDGEMENTS

This work was supported by: VEGA 1/0202/15 Bezpečné a udržateľné hospodárenie s vodou v budovách tretieho milénia/ Sustainable and Safe Water Management in Buildings of the 3rd. Millennium.

REFERENCES

Dunett, N., 2004. Kingsbury, N., Planting green roofs & living walls, Timber press, Portland*Oregon, 9-82

Nakano, M., Rousseau, N., Henderson, D., 2014. Green roof plants: Establishment, viability and maintenance. http://www.kpu.ca/sites/default/files/Facilities%20Services/Sustainability%20at%20KPU%20%20where%20are%20we%20now%20%20Saima%20Zaida%20Final%202014%2001%2030_0.pdf (20-02-2014)

Snodgrass, E. C., 2006. Green roof plants. Timber press, Portland*London, 11-88

Theodosiou, T., 2003. Summer period analysis of the performance of a planted roof as a passive cooling technique, Energy and Building

Thuring, C. E., 2014. Green roof plant response to different media depth under various drought conditions. http://horttech.ashspublications.org/content/20/2/395.full (20-02-2014)