GREEN ROOF OR ROOF GARDEN?

ACOPERIŞ VERDE SAU ACOPERIŞ GRĂDINĂ?

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Abstract. *Far from being news to civilized countries, green roofs are slowly starting to spread in Romania as well. Vegetation up high becomes a necessity because of the spread of built areas, which diminishes green areas. This can be a solution in the attempt to compensate for the loss caused by the inevitable urban development. There are two concepts available,"the green roof" and the "roof garden". There are several differences between the two, such as place and placement mode, the type of system chosen and adequate vegetation for each. This paper will analyze these two concepts, ending with a set of conclusions and recommendations concerning the purpose and the benefits of each.*
Key words: ecoroof, landscape over structure, extensive system, intensive system, substrate, rehabilitation

Rezumat. *Departe de a fi o noutate pentru ţările civilizate, înverzirea acoperişurilor îşi găseşte încet locul şi în România. Extinderea zonelor construite în detrimentul spaţiilor verzi face ca prezenţa vegetaţiei pe clădiri să devină o necesitate. Se poate astfel compensa ceea ce se pierde prin inevitabila dezvoltare urbană. În acest sens există două concepte, cel de acoperiş verde şi cel de acoperiş grădină. Acestea se diferenţiază prin mai multe aspecte, printre care locul şi modul de realizare, tipul de sistem ales şi vegetaţia care se pretează pentru fiecare în parte. În acest articol se va realiza o analiză a celor două concepte, prezentând în final concluzii şi recomandări referitoare la rolul fiecăruia şi la beneficiile aduse de acestea mediului înconjurător.*
Cuvinte cheie: acoperiş înverzit, sistem extensiv, sistem intensiv, substrat, reabilitare

INTRODUCTION

The idea to grow vegetation on a roof is not contemporary. Information on such a vegetation cover dates back to Ancient times. The first examples come from Mesopotamia, the well-known "hanging gardens" of Babylon, roofs with luxuriant vegetation and vegetative terraces (Velazquez, 2005). In extreme climate countries, either very cold or excessively hot, traditional housing with vegetative rooftops was chosen hundreds of years ago in order to regulate or keep constant interior temperature. In Iceland, for instance, traditional houses of the sodhouse-type were made out of peat. Their roof was covered with grass and during wintertime no other heating was required besides human-generated heat. The roof of these houses was made out of two

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or three layers of peat laid on tree branches and twigs and covered with a thick layer of grass patches (Minke G., 2010).

An interesting example that clearly influenced the development and spreading of modern vegetative roofs can be found in 19th century Berlin. It was then that the so-called *holzzementdach* were placed upon four-store buildings with flat roofs towards an interior backyard. Wooden tar was used in between the card box layers in order to ensure sealing. This layer was covered with gravel and clay for fire resistance. Spontaneous vegetation usually developed onto these roofs. (Minke, 2010).

Complex vegetative systems were implemented in many regions over the time, with various aims. In Germany, the country that laid the foundations of the modern vegetative system and related legislation, the main aims were environmental concerns and the fight against the loss of green areas caused by the expansion of the built-up areas.

In North America, the aims were related to economic efficiency. In Norway, these initiatives tried to re-establish a link between nature and traditional buildings and to ensure the latter's integration in the landscape.

The United Kingdom also started to use the potential of the new technology (Dunnett and Kingsbury, 2008).

This concept is relatively new for Romania and it comes at a favourable time, as architects focus more and more on saving energy and protecting the environment. It can be seen as an attempt to regain the green areas which were lost in the wake of the chaotic urbanisation process during the last few years.

Using this type of vegetative roof for new buildings or existing ones contributes to a rational land use. It also compensates for the loss of green areas due to the expansion of urban built-up areas. Vegetative roofs are not only pleasant to look at, they also create valuable biotopes, improve air quality and have important physical and building-related advantages. 10 to 20% of the total roof area should be covered with vegetation in order to ensure a healthy climate in urban areas. Supposing that one third of the total urban area is covered by buildings and another third by streets and squares, only another third is covered by green areas. Therefore, if every fifth or tenth roof would be covered by vegetation, then urban green areas would double (Minke, 2010).

MATERIAL AND METHOD

What is a vegetative roof? The concept refers to an entire system which uses vegetation and its growing media in order to improve the performances of a supporting structure (Snodgrass and McIntyre, 2010). There are two types of concepts, defined by the degree of vegetative insertion, namely the **green roof**, an extensive system, and the **roof garden**, an intensive one.

The present paper is a comparative analysis of the two vegetative systems, mainly based on references to existing studies. According to their structure and their role, they both contribute to the development and rehabilitation of the built-up areas and therefore to improving life quality.

RESULTS AND DISCUSSION

Vegetative roofs can be planted on any type of roof, both on new buildings and existing ones, irrespective of the height and type of supporting structures, flat or sloping. In order to choose the optimal system for each particular case, we have to consider the structural, climatic, and usage restrictions, as well as the aims of the greening process.

The concept of **eco-roof, green roof** or **living green roof** implies an **extensive greening system** and it is a modern adaptation of the roof garden. Its benefits are mainly functional, namely to protect the waterproofing layer, by sealing and endurance, and also to retain some of the rainfall water. The reduced width of the substrate imposes a limited variety of plants, which entails a simple design, a lack of flexibility and a bland landscape. This aspect might be compensated by the fact that different species and types of plants can be used in order to bring in variety of texture and colour. The weight of the whole system is relatively low and does not involve a massive supporting structure, or additional reinforcement in the case of existing buildings. The maintenance of the extensive system is not expensive and permanent access during exploitation is not required. The implementation costs are low and the system is suited for any type of roof, be it flat (fig. 1) or sloping (fig. 2).

Fig. 1 - Extensive green roof – flat supporting structure (www.greenroofsolutions.com)

Fig. 2 - Extensive green roof – sloping supporting structure (www.greenroofromania.blogspot.com)

Germany is the country with the most advanced implementation of green roofs. Around 14% out of the total flat roofs (13.5 million square meters) were covered in vegetation in 2001 (Snodgrass and Snodgrass, 2010). The extensive system was used in 80% of cases (Carter and Butler, 2008), proving that the cost-benefit ratio favours simple, extensive green roofs.

Landscape over structure or **roof garden** imposes an **intensive** vegetative **system** which is suitable only for flat supporting structures. The benefits of this system are comparable to those of a proper green area at pavement level, plus the benefits of an extensive green roof. The thickness of the substrate allows for a large variety of plants and better thermal and phonic insulation, plus better results in retaining runoff. The landscape offered is more attractive, as the green areas can be organized in a more flexible and

diverse way (fig. 3). The advantages for the environment are also more significant in comparison to the extensive system. Nonetheless, the intensive system is implemented on a lower scale because it is expensive, needing constant maintenance and irrigation. Moreover, its implementation is more difficult because it weighs more and it adds an extra load to the building resistance structure. This type of system is used for roofs which are accessible to people, which means ensuring easy access and additional protection measures, such as parapets and protection guardrail (fig. 4).

Fig. 3 - Intensive roof garden (www.naturalpatriot.org)

Fig. 4 - Intensive roof garden (www.optigreen.com)

The structure of a vegetative roof includes the same elements, irrespective of the system chosen: supporting structure, waterproofing membrane, root barrier, drainage panel, filter fabric, substrate (growing media) and vegetation.

When designing any type of vegetative roof we need to consider the following factors: the climate of the region, local microclimate, annual rainfall pattern, drought periods, frosting periods, direction and speed of dominant wind, whirls and air currents, exposure and sunshine rates, the ability of nearby surfaces to reflect light and the type and intensity of polluting emissions (Dabija et. al., 2011).

The significant difference between the two systems is given by the width and the structure of the substrate and implicitly by the vegetation it can support (fig. 5).

The substrate has to have a high water retention capacity. It has to ensure air permeability and to have a stable structure, exchange capacity and high buffer power (Dabija et. al., 2011). Growing media used for vegetative roofs can be natural, artificial and of mixed origin, according to their composition. Natural ones are rich in organic material and microbial flora and have an instable physical and mechanical structure. Artificial media are obtained by industrial manufacturing of rocks and chemical substances synthesis, organic by-products from oil distillation. They are more uniform, poor in nutrients and organic material. They maintain their structure for a longer period of time and cannot be used without added nutrients. The mixed type includes components from both groups mentioned above, in various quantities. They can be combined in various ways, according to the

specificities of each material and the specific needs the plants have (Dabija et. al., 2011).

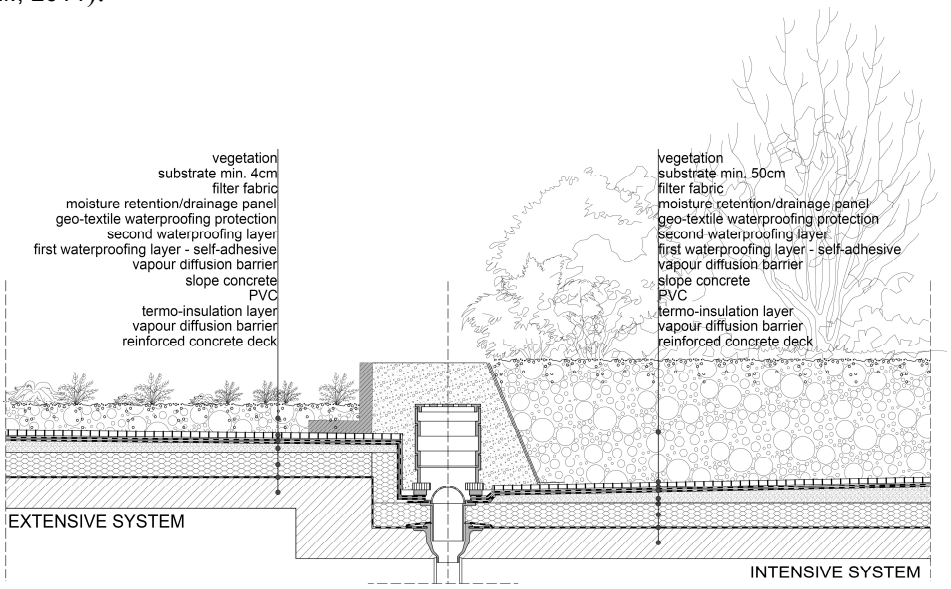

Fig. 5 - Vegetative roof. Structure.

In the case of extensive green roofs, the minimum thickness of the substrate is 4cm, its specific weight is low and its components include a mixture of peat, perlite, vermiculite, earth from dead leaves, expanded plastic material. Intensive roof gardens have a substrate that depends on the needs the plants have, with a minimum thickness of 50cm (Dabija et. al., 2011).

Several factors must be considered when selecting plants to be grown on a vegetative roof: the thickness of the growing media and its ability to retain water, the slope, wind exposure, orientation in relation to cardinal points, rainfall. The criteria to be complied with when choosing the vegetation are: resistance to frost, resistance in time, growth height, plants which develop vertically and not so much on the horizontal (Minke, 2010).

Extensive green roofs are formed of succulent plants and moss. Usually, local plants are used, since they are adapted to survive in extreme climate conditions and ensure a natural growth of vegetation, without needing special care. The intensive roof garden consists mainly of perennial herbaceous, bulb-rhizome plants, shrubs, bushes and even woody vegetation. The range of design is wide and the same principles as for ground vegetation can apply. (Dabija et. al., 2011).

CONCLUSIONS

1. A successful vegetative roof depends on the proper choice of the best system that suits the needs of that roof. The extensive *green roof* is better suited

for the rehabilitation of existing buildings, with a flat or sloping roof, since their structure cannot support additional loads. On the other hand, the intensive type, the *roof garden* can be successfully implemented mainly in the case of new, public or private buildings, where the supporting structure can be designed in order to support the extra weight.

2. The benefits of having vegetation and related layers on the roof of a building are obvious: they improve the aesthetic image, purify the air by absorbing carbon dioxide, release oxygen and filter dust and polluting emissions; they increase thermal and phonic comfort due to the additional insulation and therefore reduce costs for maintaining an optimal interior temperature; they reduce humidity variations, retain excessive water runoff, prolong the life of supporting structures and reduce the greenhouse effect.

3. Vegetative roofs are a solution for the rehabilitation of urban areas, a topic which concerns us more and more. They improve life quality and help develop biodiversity and the urban microclimate. In conclusion, green roofs bring multiple benefits for sustainable development in our cities and this investment is one worth making.

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