RESEARCH ON SUSTAINABLE METHODS OF MAINTENANCE OF GREEN ROOFS

CERCETĂRI PRIVIND METODE SUSTENABILE DE ÎNTREȚINERE A ACOPERIŞURILOR VERZI

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Abstract. *The practice of developing vegetation roofs can be said to have ancient origins, proof being the legendary Babylonian hanging gardens that were decorated with trees and flowers on top of the palaces. As a result, today, this attractive practice has a high environmental value and therefore in this paper we present methods through which we want to add the new valency of ambiental improvement and safety in maintenance green terraces, thanks to new modern technologies available at the moment. Special attention was paid to drainage and water retention in order to adjust stratigraphy of green terraces. Thus, by reducing the weight and reducing the costs of maintenance activities, it was determined that the time evolution of the roof is directly related to the economic and environmental sustainability of the system and as a result, three levels of maintenance have been defined. In achieving these levels two fundamental aspects have been highlighted: a visible one, mainly related to aesthetic aspects and another, imperceptible at first glance, involving the elements of structure, protection, maintenance and safety.*
Key words: green roof, sustenability, landscape design

Rezumat. *Practica amenajării acoperişurilor cu vegetaţie putem aprecia că are origini antice, dovadă fiind legendarele grădini suspendate babiloniene care ornau cu arbori şi flori partea superioară a palatelor. Drept urmare, în zilele noastre, această practică atractivă are o ridicată valoare ambientală şi, de aceea, în cadrul acestei lucrări sunt prezentate metode prin intermediul cărora se doreşte să se adauge fascinantelor terase verzi, noi valenţe de ameliorare ambientală şi siguranţă în întreţinere, graţie celor mai moderne tehnologii disponibile în acest moment. O atenţie specială a fost acordată drenajului şi retenţiei de apă în scopul ajustării stratigrafiilor teraselor verzi. Astfel, prin reducerea greutăţii şi diminuarea costurilor activităţilor de întreţinere, s-a determinat faptul că evoluţia în timp a acoperişului este direct legată de sustenabilitatea economică şi ambientală a sistemului, şi drept urmare s-au definit trei nivele de întreţinere. În realizarea acestor nivele s-au evidenţiat două aspecte fundamentale: unul vizibil, în principal legat de aspectele estetice şi altul, imperceptibil la prima vedere, care implică elementele de structură, de protecţie, de intreţinere şi de siguranţă.*
Cuvinte cheie: acoperiş verde, sustenabilitate, design peisager

INTRODUCTION

If we think of the legendary Babylonian hanging gardens that decorated with trees and flowers the superior part of their palaces, we can appreciate that

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terraces and roofs adorned with vegetation have ancient origins. Even today, this attractive practice has a high environmental value and, therefore, the theme of this work is to add new decorative valences and ambient improvement, fascinating green terraces, maintenance safety and waterproofing safety thanks to the most modern technologies available at the moment.

Special attention is paid to drainage and water retention in order to increase green tertiary stratigraphy by reducing the weight and reducing the costs of maintenance (Compagnone, 2009).

Taking into account the advantages of this arrangement, namely increased rainwater retention, smog and dust reduction, noise reduction, thermal insulation enhancement, effective protection of waterproofing against ultraviolet rays (Niachou *et al.,* 2001), waterproofing against thermal stress generated by temperature variations day-night/summer-winter, protecting the waterproofing against mechanical stress, improving the quality of life, the integration of the real estate in the natural environment and, last but not least, increasing the value of the real estate (Ekaterini and Aravantinos, 1998), the work focused on the study of some methods of maintenance of the roofs, considering that the degree of involvement in this technical segment leads to increased use period and, at the same time, to lowering the costs and the actual maintenance time (Dascălu and Paşcu, 2016).

Designing in the field is guided by a series of standards that regulate roof landscaping (Haggas, 2006), some of which are presented in table 1.

Table 1

Standards in the field of coatings

ELEMENT	FUNCTION	APPLICATION	THE STANDARD WHICH REQUESTS THE NORM 'CE' ON PRODUCTS
Support elements	Protection	Coverage	EN 13953
Isolating element for the root action (integrated or not)	Root limiting barrier	Coverage	UNI EN 13978 plus the declaration of conformity that the membrane serves the green terrace applications
Drainage element	Drainage	Coverage	EN 13952

MATERIAL AND METHOD

The present paper analyzed in the smallest detail the development of flexible systems of green roofs, suitable for adaptation even on surfaces defined by complex structures (Cirstolovean, 2007) and with different inclinations. An example is the green terace with a steep slope, where the materials and maintenance solutions guarantee a constant and uniform greening. Layer structure details for this variant, depending on the degree of inclination, are shown in figure 1.

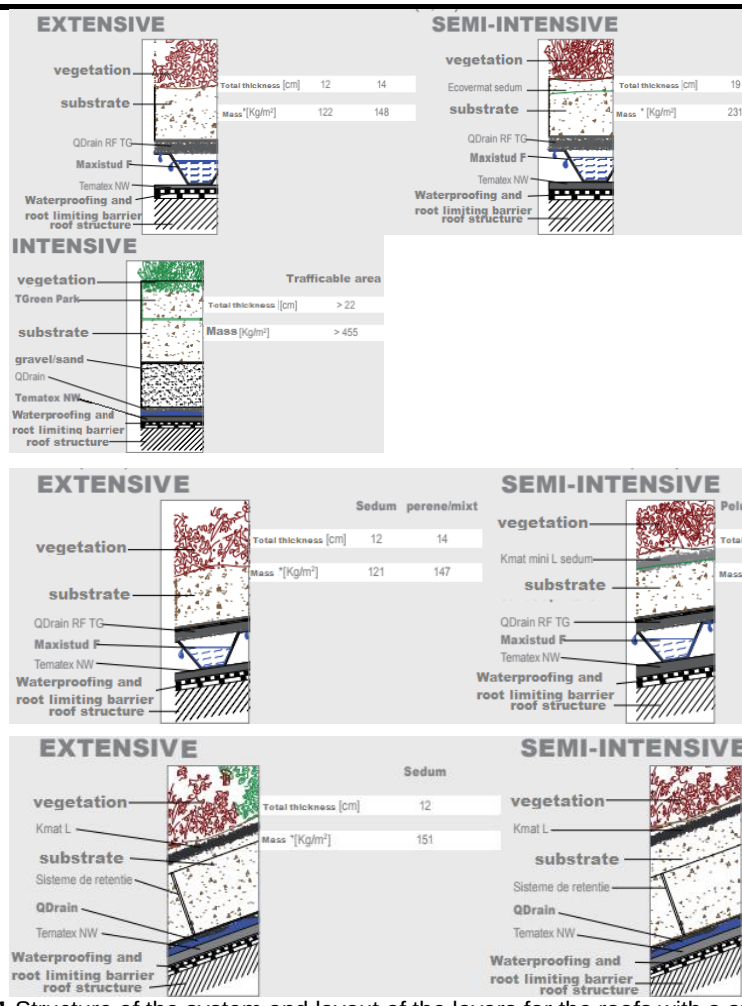

Fig.1 Structure of the system and layout of the layers for the roofs with a surface inclination a. small <5% (2.9 °) b. average <15% (8.5 °) and c. high <45% (24.2 °)

The construction system used consists of basic elements (primary elements), secondary layers and equipment that can be used in accordance with product operating recommendations, climatic and field conditions. The primary elements are made up of a carrying element, a supporting element, a root-protective element (integrated or not), a mechanic protection liner (Tematex NW), a draining element (QDrain TG), an water retaining element (Maxistud F) and a filter element (www.maccaferri.com) over which a culture substrate has been deposited. The last layer is being represented by the selected vegetation composed of species belonging to the genus *Sedum* (Negrea *et al.,* 2014) and other genus of poaceae and gramineae (Emilsson, 2008). Besides these primary elements, the secondary layers and the complementary equipment that make up a green roof consist of a vapor barrier layer, a protective layer, a thermo-insulating layer, a slope layer, a primer layer, a

leveling layer, vapor pressure diffusion and/or equalization layer, stiffening and unloading layer, separation layer and/or slag layer, protective layer, ballast layer, anti-erosion coating (Kmat L) and irrigation system (fig. 1).

RESULTS AND DISCUSIONS

In order to quantify the results, it was intended to observe the current standards in the field of coatings and to define the green roof system according to the total mass of the water-saturated system (Kg/m^2), the total thickness of the system (cm) and the compatibility with climate zone [adaptability to climatic zone 2 (Haggas, 2006)].

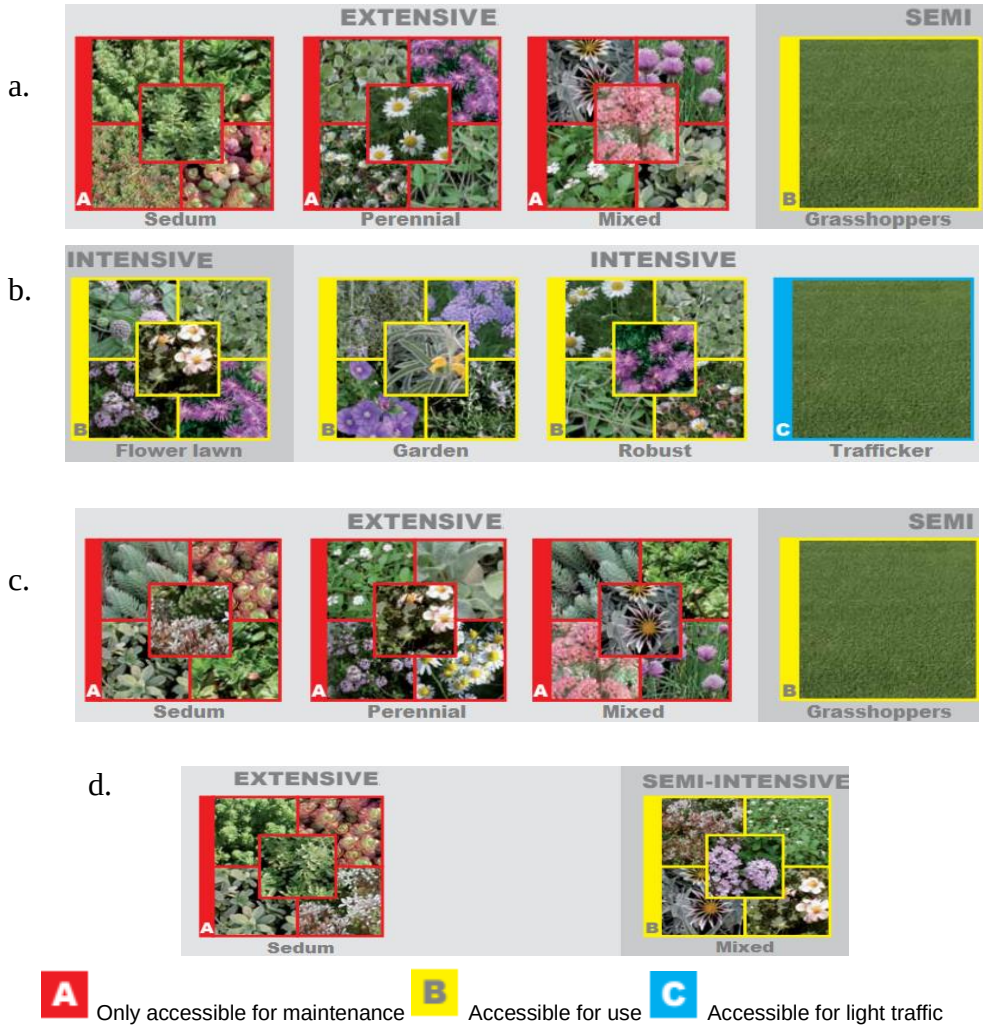

Fig. 2 Surface with: a and b with a low slope <5% (2, 90 °), c. with a mean slope <15% (8.5°), and d. with a steep slope <45% (24.2°)

The study found that green roofs had three different maintenance classes.

The three levels of maintenance differ according to the difficulty of maintenance work and their frequency:

- Class 1: Easy maintenance (extensive)
- Class 2: Medium maintenance (semi-intensive)
- Class 3: Frequent maintenance (intensive)

Easy Maintenance: (extensive system – fig. 2) to which maintenance interventions are limited to controlling system elements. Especially vegetal layers are checked by monitoring the physiological and phytosanitary status of plants, checks on the presence of parasites and weeds that may adversely affect the system's functionality. Irrigation can be done occasionally only to keep plants in unusual drought conditions alive.

The study found that for light maintenance coverage an intervention program of about 3 days a year could be foreseen at an area of 1,000 m^2.

Medium and frequent maintenance: (intensive system – fig. 2.a.) in which maintenance interventions include the verification of the system elements and the vegetation layer already foreseen in the intensive system to which all the agronomic activities necessary for the correct management of the green space . Avoid using improper equipment for such interventions. Irrigation will be specially designed only when it is necessary to maintain the green roof permanently.

By reducing the weight and maintenance costs, it has been determined that the time evolution of the roof is directly related to the economic and environmental sustainability of the system.

The results obtained from the study revealed two fundamental aspects: a visible one, mainly related to aesthetic aspects and another, imperceptible at first glance, involving elements of structure, protection, maintenance and safety.

CONCLUSIONS

Roof maintenance is directly related to the economic and environmental sustainability of the system and is necessarily assessed from the design stage by determining the maintenance costs.

The evolution in time of the roof is directly related to the economic and environmental sustainability of the system by reducing weight and reducing the cost of maintenance.

Also, this type of arrangement, by its novelty degree, offers the possibility for the active involvement of designers, builders and beneficiaries in assisting at the design phases as well as testing new environmentally friendly products in the context of the roofing sustainability and green terraces.

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