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University of Antioquia

## **ENVIRONMENTAL BENEFITS OF GREEN ROOFS**

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English level IV

April 4 of 2014

# CONTENT

<b>Introduction .....</b>	<b>Page 3</b>
<b>Theoretical framework.....</b>	<b>Page 4</b>
<b>Conclusions.....</b>	<b>Page 8</b>
<b>Bibliography .....</b>	<b>Page 10</b>
<b>Annexes.....</b>	<b>Page 11</b>

# Introduction

The building in which we live, work and play protect us from nature's extremes, yet they also affect our health and environment in countless ways, because the construction of buildings consumes more than half the materials we gather from nature and half the world's energy. The pollution from buildings, including air, light, and electromagnetic pollution, accounts for 34 percent of total environmental pollution (Minzhen, 2012).

As the environmental impact of building becomes more apparent, a new field called "green building" is gaining momentum. Green, or sustainable, building is the practice of creating and using healthier and more resource-efficient models of construction, renovation, operation, maintenance and demolition (EPA, n.d.).

Copies of green buildings are green roofs, which are roofs with gardens. The precursors of contemporary green roofs have ancient roots. The earliest documented roof gardens were the hanging gardens of Semiramis in what is now Syria, considered one of the seven wonders of the ancient world. The modern green roof originated at the turn of the 20<sup>th</sup> century in Germany, where vegetation was installed on roofs to mitigate the damaging physical effects of solar radiation on the roof structure (Oberndorfer et al., 2007).

It has been said that green roofs are environmentally sound technologies as influence on improving the climate of the city, also optimize the thermal insulation and acoustic insulation. Moreover they are considered in the long term, more economical than conventional roofs (Minke, 2010). This has motivated the implementation of such technology is increasingly prevalent in contemporary buildings. However, the construction industry requires metric weight to justify designs sustainable construction through the development of indicators and tools for evaluating the economic and environmental performance of the life cycle of this type of construction (Helgeson, Lippiatt, Helgeson, & Lippiatt, 2009).

Thus, this study aims to inquire about the environmental benefits of green roofs in the city. To achieve this goal is to follow a methodology based on the review of the

literature, taking into account the information published in sources with technical and scientific sense.

## **Theoretical framework**

**Abstract:** In this paper we made a literature review to investigate about the environmental benefits it brings the construction of green roofs. We found that within these benefits are: The regulation of hydrological cycle, regulating the flow of energy in cities and preserving biodiversity and habitat. We also found it necessary to make a cost-benefit analysis in the Colombian context, to assess the feasibility of this technology not only from an environmental point of view but also from an economic point of view.

### **Environmental benefits of green roofs**

Now, the question that we want to answered is: what benefits bring the green roofs to the environment?

In environment terms, the green roofs give us great benefits. Some of this are:

#### **REDUCTION OF TEMPERATURE**

During warm days, the urban areas usually have temperatures among 1 to 4.5 degrees Celsius higher than the surrounding, this phenomenon is usually known like “Heat island effect” or “urban heat island”. The gradient intensity varies depending of weather, topography and urban design.

We can see many examples of this phenomenon; New york is in average 3.6 to 5.4 °C warmest than his suburbs. But in the tropical cities, this effect is higher.

In the case of our city, Medellín, the difference between urban zone and suburbs is 7°C of temperature (average).

The heat islands are set when the dark and impermeable surfaces absorb heat and radiate it again at the atmosphere. The quantity of energy who reflects a surface defines how much heat gain, is called “Albedo”, and is measured between 0 and 1.

(0 is for high temperatures and 1 is for low temperatures). In other words, we can say that a high albedo “Cooled the planet”.

The albedo in a roof of slab or paving stone is 0.08 percent, but the albedo of a green roof is 0.25 in average. In fact, pavement and concrete are the surfaces that more absorb and radiate thermal energy. And is right here where we can see the great importance of the green roofs in the environment. With green roofs, the Heat island effect is mitigated for the higher albedo in this surface and contributes with a fresh house and fresh city.

But not only for his albedo, the green roofs may keep us fresh; The humidity absorbed for the plants helps too. How?. Well, through the process of evapotranspiration, the plants can cool the air around.

In synthesis, the green roofs bring 2 important benefits to reduction of temperature. While the temperature of a asphalt roof can be increased to 70° Celcius, the temperature of a green roof rarely exceeds 26°C.

### **Hydrology: Managing stormwater with green roofs**

In addition to the temperature rise, urban development disrupts the natural movement of water, known as the hydrologic cycle. Precipitation cannot infiltrate the asphalt and concrete, and therefore drains, potentially flooding the city.

Green roofs offer an alternative since they retain and detain rainwater, thereby reducing the volume of runoff and reducing the speed with which water reaches the systems rains. Research has shown that green roofs have the ability to retain 50% of water from rainfall of 30 mm. Has also been shown that green roofs can slow water drainage time from 30 minutes to four and a half hours, and to reduce its rate of 42-96%. Green roofs also act as filters, reducing the pollutant load reaching sewers. The plants and soil captured air pollutants and heavy metal particles bind dirt molecules.

## URBAN ECOLOGY: BIODIVERSITY AND HABITAT

Green roofs promote biodiversity and help to create conscience about our relationship with mother nature. But the destruction and fragmentation of habitat, the contamination, and the noise in the big cities, made this a hostile place for most of species. Green roofs represents an habitat healthy and a good view in the cityscape. But also we can find birds and great variety of native species of fauna and flora.

### GREEN ROOFS IN COLOMBIA

→ In our country isn't common find green roofs however, some structures want give example. This is the case of the environment ministry in Bogotá, like we can see in the picture.



→ Another case in Bogotá is the construction of green roofs in the bus stops which has by objective rainwater retention, create green spaces and reduce the heat effect.



→ In some buildings in Bogotá we can find interesting projects of green roofs, as they are: The office building in the st. 93 with 16; The library of Los Andes University and the Club House in the neighborhood Quinta Paredes.





→ Parque arvi was the first place in Medellín where we could find green roofs. This roofs are incredible beautiful and accomplish not only all the benefits of green roofs, but also obtained a great esthetic aspect.



→ Finally, another case that we mentioned is in our University. A green roof in the Álvaro Pérez Roldán Auditorium. We have an interview for know whom takes care of this green roof (in the annexes).

## Conclusions

Environmental services and benefits that bring green roofs are: regulating the hydrological cycle; through evapotranspiration, sensible heat regulation and the preservation of biodiversity and habitat in urban areas.

Green roofs are a useful tool for cities and that mitigate many of the impacts generated by human development. Consequently, it is important that the great cities, from agreements produced by the tips of each of the municipalities, join the global initiative and prepare a politics that allows propel green roofs in the world of construction.

Given the environmental conditions in modern cities, the development is necessary to think of them in terms of long term sustainability, and in this sense, it is essential



to consider the same construction techniques and technologies that contribute to the improvement of environmental quality in cities. This is where green roofs appear as a key point that should be promoted by the administration, in terms of the benefits they deliver. To this end, it is important to the development of clear politics and guidelines regarding the topic.

Moreover, it is necessary to delve into studies to identify species vegetation which have more to accommodate climatic conditions and area of each city life but at the same time requiring less maintenance, so you can have a catalog species suitable for green roofs in different areas of each city.

Even though there are international studies examining the cost-benefit of implementing the technology of green roofs in urban construction, you need to put this analysis in the Colombian context considering policies and country characteristics, environmental, cultural, economic and social, in order to assess the viability of this technology true.

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## Annexes

### Green Roof of Álvaro Pérez Roldán Auditorium. University of Antioquia







### **Interview**

We did an interview to who takes care of the green roof which there is at University of Antioquia, in 19<sup>th</sup> building. See below.

**Name:** Lilian Taborda

**Job:** Gardener

**What is the objective of the green roof?**

The objective of the green roof is to garnish the environment and spaces, also is to preserve plants.

**What types of plants are there in green roof?**

In the green roof there are a plants called SEDUM, these plants are native plants of Colombia, are drought resistant and grow horizontally

**How do you take care of the green roof?**

If the weather is very dry then watering twice a week, otherwise should to water once a week. When plants are overgrown, they make a pruning. This happens about every 2 months. To fertilize plants of green roof foliar fertilizer is used and if there are plant pests, fumigating with Lorfen or a biological pesticide.

**How do you do a green roof?**

For the green roof we have at University, we had in mind that plants do not grow much vertically, plus the plants do not rely heavily on water because they will be exposed to direct sunlight. It is also important to put plants in baskets and spatially distributed so as not to invade drains.

**What is your opinion about the green roof?**

I think so it is a good idea for the university to look nice and is something whose maintenance is not expensive, the most expensive are the baskets.