INTEGRATING NEW PRACTICES FOR RAINWATER MANAGEMENT IN BUILDINGS: TURNING IT INTO A RESOURCE BOTH IN TERMS OF FUNCTIONALITY AND HYDRO EFFICIENCY

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Abstract: *Respect for life and nature passes through a fundamental and indispensable source: water. For thousands of years, rainwater has been recycled using it for personal and environmental needs. Rainwater (also known as "blue gold") is a sufficient asset that nature has provided us with. Every day more rainwater harvesting becomes even more necessary. During 28 years of democracy in Albania, even the city of Durrës has been subject of massive social economic changes. Because of its characteristics, offering economic and social opportunities, after 1990, it has become one of the most attractive cities for massive population migration from rural areas. This has led to an urbanization process with the doubling of the population and as a result the design of low performance buildings in terms of hydropower consumption and environmental impact. The time when rainwater was treated as "waste" transported through underground sewers, without using it, is gone. In Durrës City, as a touristic city in the summer season, with growing number of tourists in the recent years, the water supply of the area has become quite problematic. It is necessary for families to effectively manage the heavy rainwaters during winter. Approximately five million liters of rainfall every year in Durrës, that evaporate and go to the sea.*
*This study seeks to integrate new practices in rainwaters management, planning and design by demonstrating how we can turn this natural resource for sustainable development. The study adresses to an effective planning and management of rainwater inside and outside home, not only in buildings that will be designed in the future, but also i*n the existing ones.

Keywords: *rainwater management, sustainable development, hydro efficiency*

INTRODUCTION

Rainwater is a main source of the drinking water in the planet. It is known, that rainwater is contaminated with different substances. The level of contamination can vary in function of place and season. Usually first rainwaters are more contaminated than the following. So, it is necessary, to treat the rainwater with regard to the degree of contamination. Collection and practices of collection can be classified in two categories: from ground and from roof drainage system.

The first category is the water collected from ponds, that can be used for irrigation, before going to the sea. The second category is the collection of the water that flows from the roofs before it

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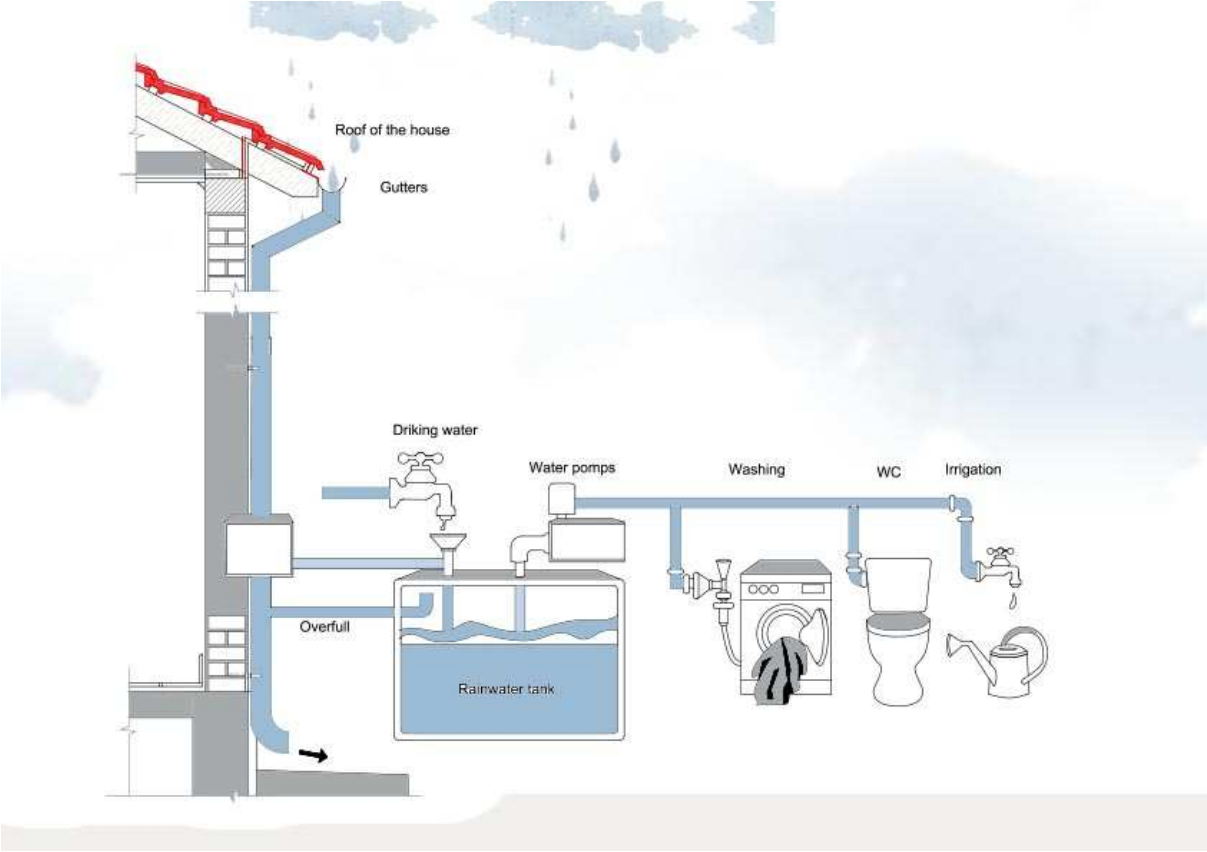
falls in ground and be absorbed by it. Simply and without consumption. Because of different roof top shape, not all the roof water can be collected. This depends on the top shape coefficient (0.6 - 0.8).

This systems of water collection produce a contaminated water that need to be treated before use. The level of treatment depends on the use of water, e.g. drinking water or water for washing and irrigation of the plants [1].

Figure 1: Use of water for indispensable needs [2]



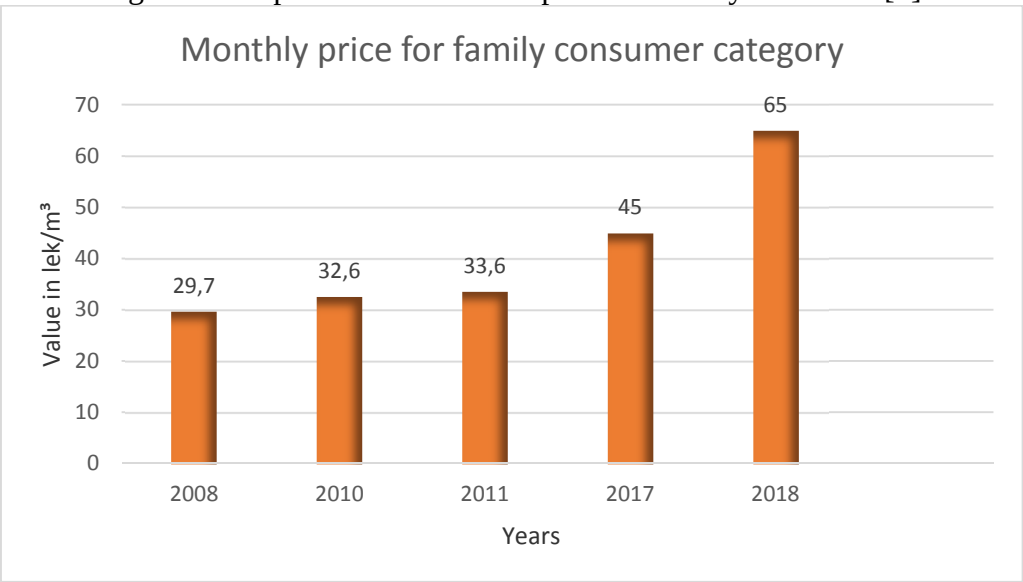
As we plan to collect and store rainwater we should concentrate on:

- the collection and store system. It must be designed in order to be far away from the possible contamination sources,
- the tank volume has to be sufficiently big in order to cover the consumer needs for water up to the next rain, especially in winter, in order to reduce a monthly expense on water consumption,
- different use of the water: cleaning, washing, irrigation, personal hygiene etc. [2].

OBJECTIVES

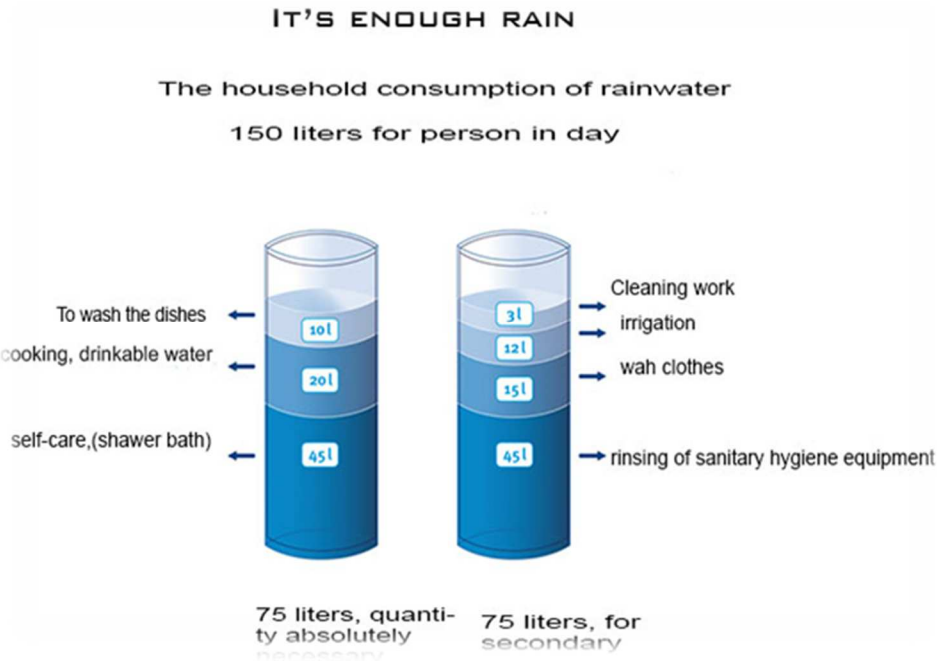
The price of drinking water is becoming more and more expensive for the consumers. The value of drinking water per cubic meter of household consumption is increasing over the years. The following graph shows the fee fluctuations of annual water consumption for family consumer over the years.

Figure 2: Graph of annual consumption for family consumer [3]



This increase makes wonder if it is worth investing in to find a way to reduce the water consumption bill. This depends on the water use from each family and each member of it. One person for indispensable needs consumes on average 75 litres of water/day, and for service needs other 75 litres that are categorised as shown in figure 3 below.

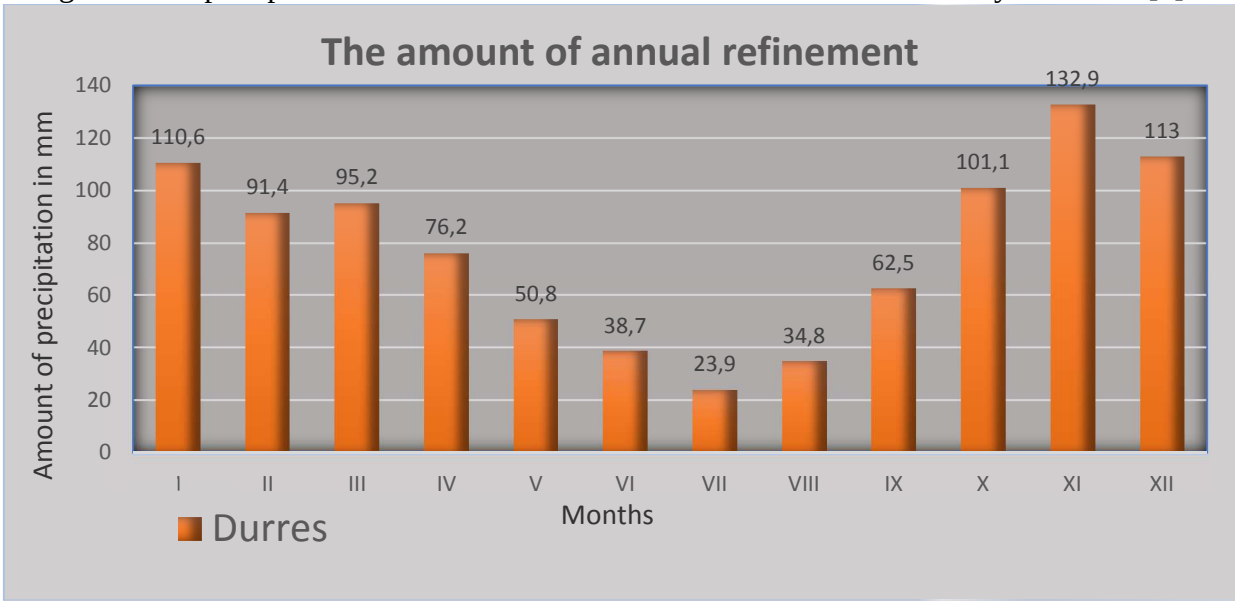
Figure 3: Total daily consumption for a person [2]



- Average number of members for a family: 4 persons,
- Average water consumption for a family: 4 persons x 75 litres = 300 litres of water a day,
- Annual consumption for a family: 300 x 365 days of the year = 112 500 litres of water in a year.

Following the data of the Institute of Hydrometrology of Albania, the annual quantity of rainfall in the city of Durrës is on average 963.4 mm in 116 days of the year [4].

Figure 4: Graphic presentation of annual rainfall amount for 2018 in the city of Durrës [5]



The shape and the roof footprint play an important role in determining the amount of precipitation. For 100 m^2 of roof, 1 – 2 litres of water are obtained in a min (in our calculations we will consider an average value of 1.5 l/min). For 24 hours are obtained: 1440 min x 1.5 l/min = 2 160 l/day of water. Total number of rainfall days 116 days x 2 160 l = 250 560 litres of water in a year [1].

If this quantity of water is managed and collected rightly, then the quantity of annual water consumption for family will be reduced. If there is not possibility to collect rightly this quantity of water, then either we will increase the size of the collection system or use the other source of the drinking water supply system from the public network.

Case study 1

The building under study was built in 1976 at the request of the Executive Committee of the district of Durrës. The building includes 3 residential floors. During the period under construction, residents were supplied with potable water from the public network. Over the years, with the advent of democracy, the number of people in the city has been increased significantly, as the seaside town in the summer season awaits a considerable number of tourists, which increases the need for drinking water, reducing it to a timetable determined by the municipality. Rainwater collection stands as the closest solution to the water crisis. Rainwater recovery systems are relatively inexpensive and the whole principle can enjoy high efficiency, the only limit that is imposed is the reservoir capacity and the collection surface [6]. It is time to manage rainwater as much as possible to ease the need for drinking water.

A rainwater management facility can be implemented, that can be installed on the ground on public space because of insufficient space. A complete system for domestic collection of rainwater has the following components:

- roof footprint – the surface from which the rainwater will be obtained,
- gutters - that serve to transport the rainwater to the storage units (water tanks),

- 2 filters - one in entrance and one in exit (their function is to collect impurities and to prevent their entrance in the tank).

Total surface of the roof is 260 m².

Figure 5: Installation of the rainwater plant in an existing building [7]

Number of residents in the buiding is 48 persons. Average indispensable water needs are: 48 x 75 l = 3 600 l/day. 3 600 l/day x 365 days of the year = 1 314 000 litres of water in a year are needed by the residents of the building for indispensable needs.

For a 260 m² roof, 3.9 litres of water/min are obtained. For 24 hours are obtained: 1 440 min x 3.9 l/min=5 616 l/day. Total number of rainfall days in Durrës is: 116 days x 5 616 l/day = 651 456 litres of water in a year [2].

Case study 2

As a second case study is considered a villa with a surface of the roof of 116 m². Considering 4 residents in the villa we have the water consumption a day: 4 persons x 75 l = 300 l/day. The average consumption for a year is: 300 l x 365 days of the year = 109 500 litres of water for a year.

For a 116 m² of roof we obtain 1.74 l/min. In 24 hours are obtained: 1 440 min *1.74 l/min = 2 506 l/day. Total number of rainfall days in Durrës is: 116 days x 2 506 l/day = 290 696 litres of water a year [2].

Figure 6: Installation of the rainwater plant in the design of a building

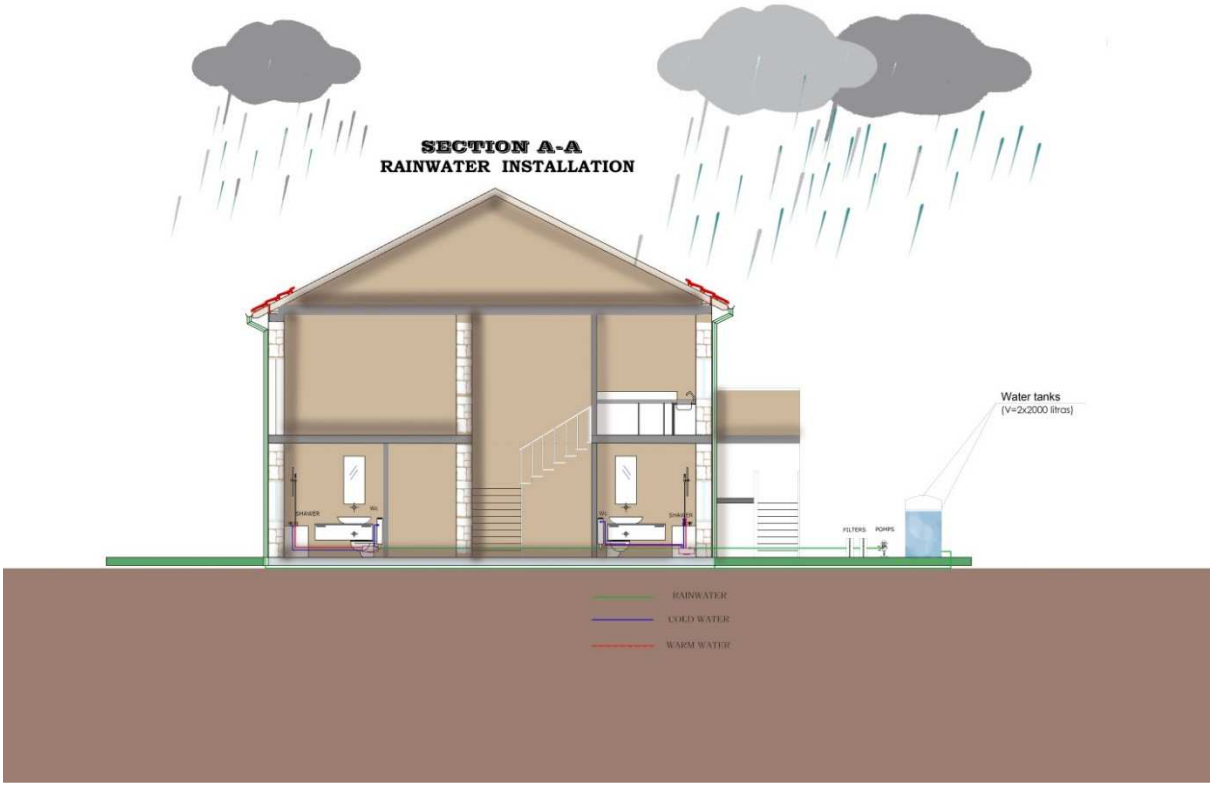


Figure 7: Installation of the rainwater plant in the ground floor

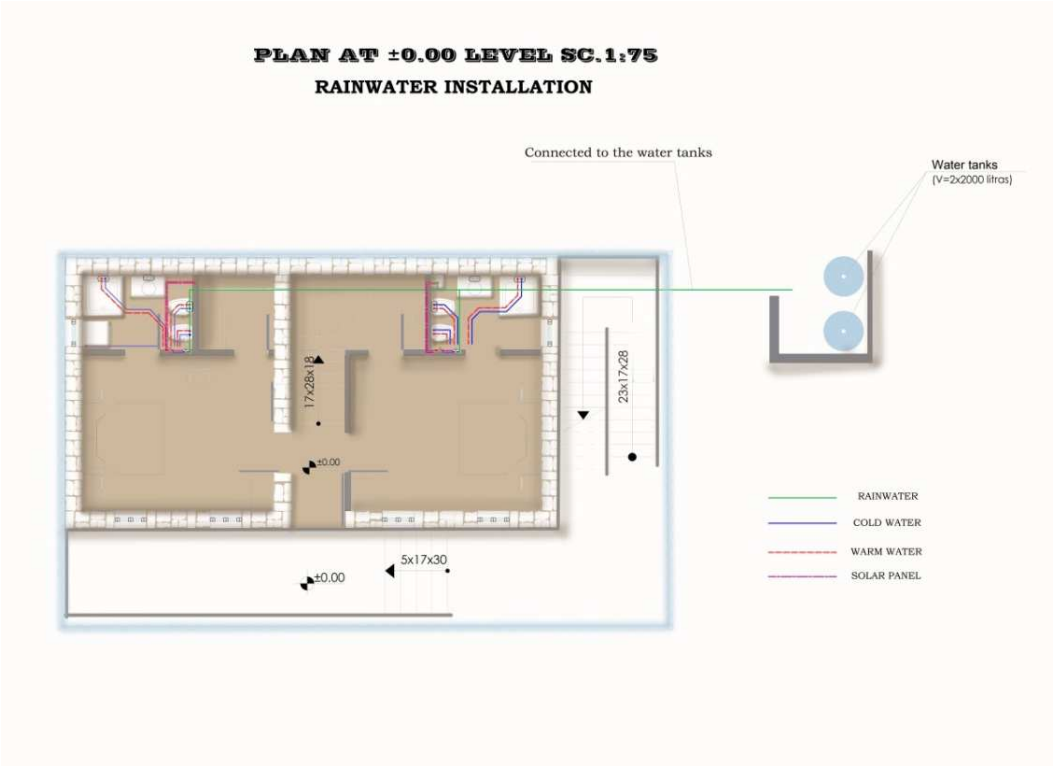


Figure 8: Roof plan

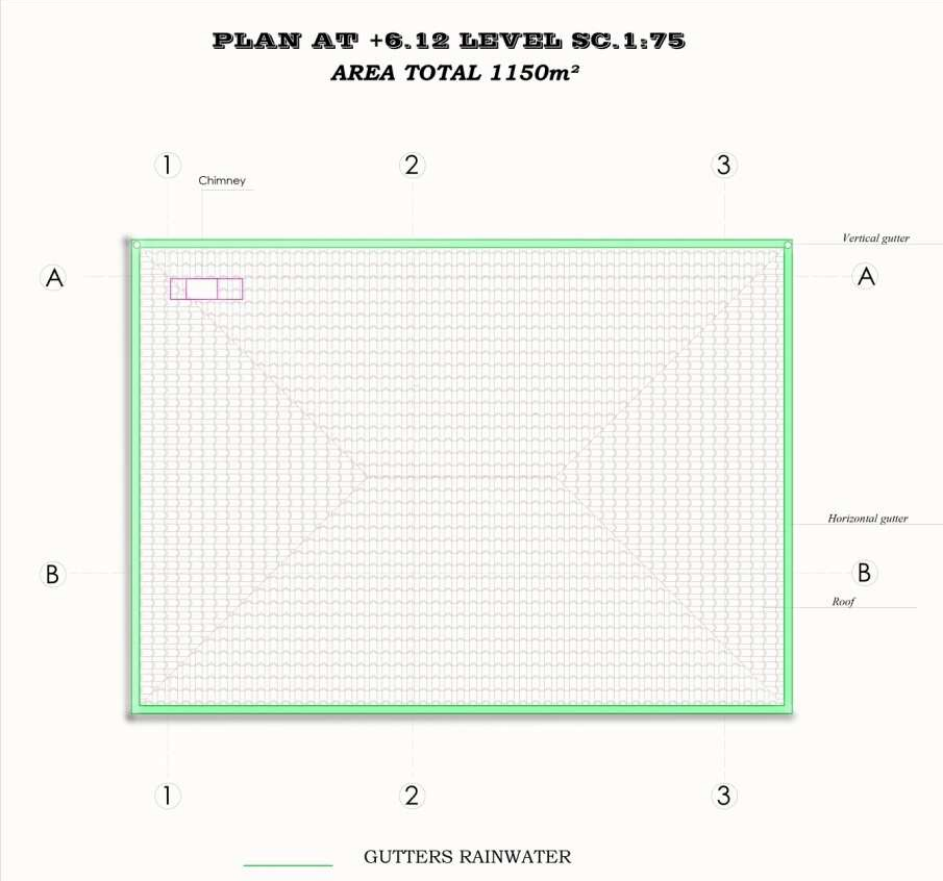


Figure 9: Transfer of the rainwater to the collector

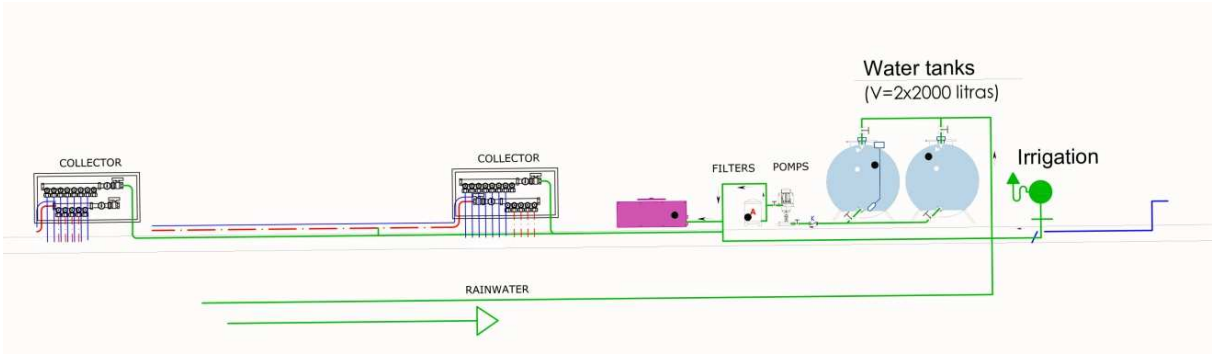
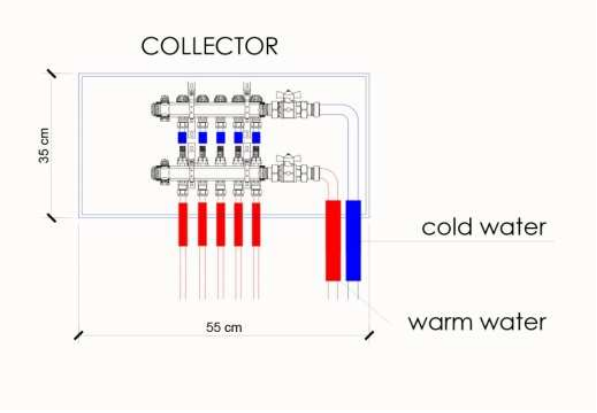


Figure 10: Collector



CONCLUSIONS

Its time to find suitable methods for recycling rainwater, and not to lose it. Each of us should contribute in this sense. The best way to collect rainwater is the installation of a system, that allows the recovery, storage and filtration of rainwater. Such a system should be studied and designed both from the structural and the aesthetic point of view. As far as cost is concerned, the full collection facility (tanker, piping, filters) can cost around 800 euros.

Anyone who wants to install such a system, predictes an economic stability for annual water expenses. Not every one has the economic condition to face the costs of such a system. This is why the rainwater accumulation system (DIY) comes in handy.

When builders and architects will build a new home or building, it is important for them to think about implementing rainwater collection methods. These methods will enable increased confidence in other natural resources for groundwater. In the long run, there will be energy savings, water savings and natural resource savings [9].

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