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Water management in a self-managed low-income housing development in south Brazil

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Abstract

The structures in the built environment, particularly concerning morphology are reflected in different housing development projects, which rely heavily on a technical insight. In this context, this research aims to analyze the implantation and typologies of a low-income housing development located in the South of Brazil. Specifically, it was analyzed the layout and style of the studied housing development, relating these characteristics with water resource planning aiming in highlighting guidelines to assist in the system design and solutions for rainwater harvesting. It is believed that this research can provide discussions on the subject and present subsidies to architectural projects.

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Keywords: Water; Social Housing Development; Rainwater Harvesting; Self-management; Sustainability.

1. Introduction

The first centralized water and sewage systems deployed in Europe in late nineteenth century changed the management of water resources in cities, mainly due to population growth, with the aim of reducing the incidence of

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diseases from sanitation (HALLSTRÖM [1]). These centralized systems should guarantee population health security, preserve the environment and also meet the city water supply, even those with reduced water availability (RYGAARD et al. [2]).

Due to increasing water demand of cities, projects using aquifers and river basins were planned and implemented to ensure water supply. Therefore, water related policies were based on supply management in terms of water demand, always seeking to increase the water supply (BARRETO [3]). However, more lately these systems have proved to be unsustainable, and despite the implementation of the before mentioned projects, security of water supply decreased in numerous regions of the world (HELD et al. [4]).

In this regard, water scarcity has become the major water problem in many cities, directly related to urban water demand increase due to population growth (BRUGGEN et al. [5]). This crisis will reduce water availability and especially affect developing countries, as already happens in the Northeast and Southeast regions of Brazil, for example, which concentrates most Brazil's population (ALADENOLA and ADEBOYE [6]).

This new scenario, according to Rygaard et al. [2], will stimulate governments to develop a new water management, characterized by water self-sufficiency of the cities made possible by new technologies and strategies for water supply with local water sources. According to these authors, the determination of strategies and technologies for water self-sufficiency is defined based on the study area knowledge, such as river basin, city, buildings, etc. In addition, the new water management will promote the integration of water resources in order to overcome water shortages, through water sources diversification, also aiming to increase local water security (SCHRAMM and FELMEDEN [7]).

For Schramm and Felmeden [7], sustainability of public water and sewage systems facing population growth depends on technologies that promote water savings coupled with energy efficiency and also allow water and nutrients recycling, such as greywater and rainwater reuse.

Regarding buildings, water management is mainly achieved through demand control, such as reducing consumption and substituting or diversifying water sources (MUTHUKUMARAN et al. [8]). In this context we highlight the use of saving equipment (CARRAGHER et al. [9]) to reduce water consumption, and the use of alternative sources such as greywater and rainwater reuse (PAULO et al. [10]; ALADENOLA and ADEBOYE [6]). In addition to technical measures, consumers' awareness campaigns should also be promoted, as changing consumption habits contribute significantly to decrease demand for water resources (WAY et al. [11]).

Among the benefits of integrated water management in buildings, it is possible to highlight: drinking water savings; reduced wastewater generation; flood mitigation through rainwater retention or detention; water sources diversification through alternative sources use; and hydraulic systems efficiency increase (KIM et al. [12]). According Carragher et al. [9], supply systems in regions where alternative sources are used have significant reduction in drinking water demand, which enables the design of smaller public supply systems.

Therefore, given the new challenges and the water scarcity in many regions, the use of saving devices, greywater reuse and rainwater use in buildings can benefit users and operators of public water and sewage systems, and contribute to the sustainability of water resources in different scales, micro (buildings) and urban (city).

In this context, the general purpose of the article is to develop a rainwater capture system for a low-income housing development located in the South of Brazil to promote the development of water resources local sustainability. Thus, the water infrastructure serves as a tool stimulate actions aiming sustainable development (MACLEOD and FILION [13]; BONTON et al [14]). The rational use of water, widespread notion for the conservation of water resources, can lead to diverse environmental impacts depending on the energy intensity of the employed technology. One of the low impact solutions is the use of rainwater.

The concern of the future of these resources also relates directly to climate change, due to the possibility of changing patterns of precipitation and evaporation in the water cycle (LUDWIG et al. [15]). Climate change and human activities may cause significant impacts on numerous hydrologic and ecological processes at various spatial and temporal scales, and has attracted the attention of the scientific community (GUO and SHEN [16]). Hence the importance of proposing a rainwater reuse system in a low-income housing development in order to foster enhanced local sustainability and cost reduction for residents.