

A Preliminary Study on the New Trend of Green Roof Design under the Background of Sponge City

Shan Liu, Shule Wei

Department of Architecture, Xi'an Peihua University, China

Abstract. In the research of this topic, combining with the existing research results and practical experience, the development direction of green roof design under the background of today's era is discussed. The new concept of green roof design of rainwater drainage and storage building guided by sponge city theory is put forward. Guided by the new concept of architectural design, the green roof design of the drainage and storage building in Shaanxi Province is empirically studied. It has important practical significance to improve the design level of the drainage and storage building. Guided by the sponge city of Shaanxi Province, it provides suggestions and references for similar design schemes in the western region.

Keywords: sponge city, rainwater drainage and storage, green roof design of buildings.

1. Introduction

After entering the new century, the global climate has been deteriorating, the number of heavy rainfall events has continued to increase. Various floods and waterlogging have caused serious losses of life and property, and become an important natural disaster factor threatening urban security. It is found that the main reasons for the increasing frequency of flood disasters are the increase of rainfall, urban construction, unscientific urban layout, increased road construction and the destruction of urban ecological environment. At the same time, water-saving consciousness of residents with scarce freshwater resources in China is weak. Statistics show that China has 6% of the world's freshwater resources, but the per capita possession is only 1/4 of the world average. In addition, two-thirds of the cities in China are in a state of water shortage, of which 18.3% are seriously water shortage. In the future of the government's accelerating urbanization construction, roads and buildings will further increase, and the proportion of impervious urban areas will continue to increase, resulting in the difficulty of timely infiltration and convergence of rainfall. At present, people's overall awareness of water saving is not high, leading to many reusable water resources have not been effectively utilized.

From the perspective of sponge city concept, the focus is on low impact design and development. Green roof is introduced into the field of architectural design. From the inside of the building, it is necessary to let the rainwater runoff complete all kinds of pretreatment (confluence, purification, etc.) and guide all kinds of low-impact development facilities in green space. Through these facilities, it can play the role of rainwater infiltration, regulation and so on. In order to reflect the real value and practical role of rainwater runoff, urban water reuse system should be applied to green space and square, thus solving the space limitations and ensuring the full utilization of rainwater in the region. Only by putting forward effective solutions according to the actual situation of different regions can the value and significance of sponge city concept be highlighted.

2. Functions and Benefits of Green Roof Design

The so-called green roof is the basic means and technical system to construct a perfect plant system on the roof plane or low angle inclined plane of urban buildings, and to use plant growth to achieve a series of purposes, such as reducing the sunshine adsorptivity of the roof, regulating the building temperature, and conserving water and soil. The roof is also called "the fifth facade of architecture", which has been less developed and utilized for a long time, and has always been idle, neglected and even spoiled by people. With the accelerating pace of urban development, greening and water surface area have also been invaded by the increasing number of high-rise buildings. In this case, many roofs have not been rationally utilized, or just as "garbage warehouses", resulting in

their value being buried. From the perspective of urban development and management, they have become human beings. Dead corners that we all overlooked. It is precisely because of this, in the relevant fields (ecological environment, urban planning, architectural design) expert recommendations, the concept of green roof has attracted more and more attention. On the one hand, it can improve the architectural aesthetics, avoid waste of resources, on the other hand, it can optimize the ecological environment.

2.1 Rainfall Management and Utilization

Green roof system can intercept and store rainwater, help to reduce peak flow value, prolong rainfall time and reduce the total amount of rainwater that must be transported after rainwater. Green roofs can absorb and hold 75% of the average annual precipitation, effectively reducing the cost of rainwater loss to the drainage system.

2.2 Adsorption of Surrounding Dust and Visible Particulate Matter and Purification of Air

As harmful gases such as vehicle exhaust and chemical plants can cause smoke problems, and there are particles, dust and other pollutants in the air itself, in order to solve these problems, it is necessary to realize building greening as soon as possible and implement this work in an all-round way. The reason is not difficult to find, with the increasing area of green space, the photosynthesis effect is stronger, and oxygen will be cleaner and more abundant. Professor Han Liebao, chairman of China Lawn Association, pointed out that 1_lawn can absorb 600 g CO ramming daily to produce 900 g O ramming. In addition, it can purify air, absorb various toxic gases and dust, reduce noise pollution, and properly change temperature and humidity.

2.3 Reducing Noise

Nowadays, with the continuous improvement of social and economic level, the scale of transportation and industrial production is gradually growing, which causes more serious noise pollution and brings great disturbance to people's normal life. Even if some sound insulation facilities can be selected for the construction, the implementation is more difficult, and it will bring damage to the city appearance and the city appearance at the same time. Considering all the above, urban green coverage will be the most direct and effective way to solve this problem. In the greening design of building roof, noise and sound waves are absorbed by vegetation layer and soil layer. Compared with the early idle roof, the noise reduction amount is about 10 db, and the effect is very ideal.

2.4 Landscape Function

In the urban high-rise environment, people can only overlook the monotonous pavement facilities, it is difficult to meet the aesthetic needs, but after the proposal of building roof greening, it will bring people a new and natural scenic line. At this stage, most of the exterior buildings are treated with waterproof paint, whether in color or form, which is relatively single. In the face of direct light, glare phenomenon often occurs, which is not conducive to people's observation. The greening treatment of the building roof enriches the city color and meets the spiritual needs of the citizens. From the aesthetic point of view, the plants of different colors and textures are full of vitality instead of gray and lifeless building surfaces.

3. "Sponge City" Concept and Green Roof Design Principles

3.1 Consider the Reuse of Rainwater Resources for Plant Irrigation

Because China belongs to monsoon climate, the distribution of rainy season is difficult to average, and winter temperature is low, rainfall is less, summer temperature is high, rainfall is more. Because the urban construction period has brought great damage to the ecological environment, leading to the dry and wet season characteristics are very prominent. In order to improve urban

rainwater collection and scientifically manage surface runoff, it is necessary to adopt relevant measures to optimize and harness ecosystems and lay a foundation for rainwater reuse. For building greening, not only to achieve the basic functions, but also to bring benefits to the ecological environment, only in this way can it be recognized as effective greening. In the process of greening practice, the index of greening coverage should be strictly controlled. Only when all requirements are met, can greening play its due role and bring more ecological benefits. At the same time, it is necessary to establish a rainwater reuse system synchronously to meet the needs of plant irrigation through rainwater, and to promote the transformation of buildings into buildings.

The real "sponge body" comprehensively improves the building value.

3.2 Waterproofing and Drainage Considering Building Load and Landscaping

Because of the uniqueness of building greening, which is also called "air garden", three requirements need to be met: first, to create entertainment and leisure venues for residents; second, to ensure safety, because it belongs to the category of high-altitude operations, so safety must be paid attention to; third, the load problem, when specific design, not only. Only pay attention to one aspect of greening, but also consider whether the layout is appropriate, whether the roof can withstand, to normal use of buildings as the premise, improve the greening work.

3.3 Full Consideration of Plant Selection in High-Rise Buildings

Because roof load-bearing has its own limit, it is necessary to select suitable soil to cultivate plants. Combined with practical experience, new materials such as artificial soil and peat soil are selected as far as possible to reduce weight. If the planting soil is thicker, the roof is difficult to support, but when it is thinner, water, temperature and nutrients are difficult to maintain, which directly affects the survival rate of plants. Therefore, light weight, no caking, water and fertilizer conservation planting soil should be the first choice. The research on the design and implementation of urban rainwater drainage and storage greening roof in Shaanxi is based on the sponge city background. In the process of architectural design, the most direct expression is the green roof design, which highlights its unique features. Green roof has gone beyond its seemingly simple meaning. Once successfully designed and constructed, it will create more benefits from both ecological and social aspects. With the passage of time, people gradually understand the value of green roofs. Through practical application, it can not only provide effective protection to the environment and improve the ecological environment, but also inhibit the heat island effect, reduce the loss of rain and flood, and maximize the utilization of urban area. Green roofs are an integral part of sustainable architecture. Greening on flat roofs is easy to implement. It is convenient to construct and maintain. The greatest advantage is that it is beneficial to soil and water conservation, reduces heat, does not occupy more space and opens up available space.

4. Study on the Design and Implementation of Urban Rainfall Drainage and Storage Greening Roof in Shaanxi

The roof is the fifth elevation of the building, which has a very important position in the architectural design. Because of the volume ratio, the density of residential buildings in some old urban areas is about 25%-30%, and the design of high-rise residential buildings in new urban areas is mostly. The volume ratio is generally about 2.0-4.0, and the density of buildings is about 15%-30%. The density of public buildings will be higher, with office buildings between 25% and 35%, commercial and financial buildings around 50%, and industrial warehousing buildings over 35%. From these data, we can see that the proportion of building roofs in urban land is relatively high, in other words, the area of building roofs is relatively large. If we can better optimize the design of these roofs, it will be very helpful to the construction of flood drainage and storage in sponge cities. (Fig. 1)



Figure 1. Green Roof Construction Reference Photo Source: Network

4.1 Simple Planting Green Roof

Simple green roof planting soil thickness is 100-300 mm, generally using lightweight improved soil or inorganic planting soil, only planting ground cover plants, low shrubs. It can be used in various roofing forms, mainly for effective rainwater management, instead of the traditional rainwater management mode. The construction methods of simple green roof (suitable for flat roof and sloping roof with 10%-20% gradient) are as follows: reinforced concrete cast-in-situ roof slab (structural slope finding) - insulation layer, 50 thick extruded polystyrene board (P=25-32) (energy saving calculation) - 20 thick 1:3 cement mortar leveling layer - puncture resistant composite waterproof layer roll 2. Road (4.0 thick elastic SBS modified asphalt waterproof roll (including chemical root blocking agent) + 4.0 thick modified asphalt waterproof roll) - geotextile protective layer, unit area mass $\geq 300\text{g} / \text{m}^2$ - 20 high concave convex drainage (storage) plate - 200g / m² non-woven filter layer - 100-300mm thick simple planting improved soil vegetation layer (lawn and ground cover are selected) Small shrubs.

4.2 Garden Green Roof

Garden green roof planting soil thickness of 300-600 mm, when planting large trees, local can be thickened planting soil. A variety of planting soils, trees, shrubs and ground cover plants can be selected, and recreational and ornamental facilities such as garden roads and benches can be set up. Generally used for flat roofs with slopes of 2% - 10% and basement roofs with slopes of 1% - 2%. Mainly used for green roofs in open space, the cost is relatively high, and the required technology is relatively complex. The construction methods of garden green roof are as follows: reinforced concrete cast-in-situ roof slab-insulation layer, 50 thick extruded polystyrene board (P=25-32) (energy-saving calculation) - the thinnest 30 thickness LC5.0 lightweight aggregate concrete 2% slope-finding layer - 20 thickness 1:3 cement mortar leveling layer - puncture-resistant composite waterproof layer coil 2 channels (4.0 thickness). Elastic SBS modified asphalt waterproofing membrane (containing chemical root inhibitor) +4.0 thick modified asphalt waterproofing membrane) - isolation layer: 5 thick lime mortar mixed with fibers - 40 thick C20 fine stone concrete protective layer - 25 high concave convex drainage (storage) water plate - 200 g/m non-woven fabric filter layer - 300-600 mm thick planting improved soil - vegetation layer (lawn selected) Ground cover, shrubs and small trees should be partially raised when large trees are selected.

Acknowledgments

This paper is a project paper entitled "Special Scientific Research Project of Shaanxi Education Department in 2019: Research on Green Roof Adaptability Design of Residential Buildings in Xi'an Area", project number: 19JK0632.

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