

Research on Innovation Driving of New Pattern Roof Greening in Guangzhou

Ying Liu

Guangzhou Vocational College of Science and Technology
Guangzhou, China 510550

Abstract—Under the background of innovation-driven strategy, this paper study by means of interdisciplinary theory, researching on coupling of the productive landscape, city building roof greening, roof rainwater collection of sponge city, urban modern agriculture, Internet plus, new energy technology innovation, putting forward new idea with the production function of the new pattern roof greening "sky garden", trying to create "air productive landscape complex" in Guangzhou city core area.

Keywords—*productive landscape; sponge city; roof greening; urban agriculture; sky garden*

I. INTRODUCTION

Guangzhou is one of the largest cities in China, and its regional advantages and economic status are remarkable. Guangzhou city is known as the "Flower City", "panicle city", which means that the flower clusters and the scenery are pleasant. The famous Lingnan culture has a long history. The continuous acceleration of the process of urbanization has led to the outbreak of all kinds of urban problems, which is extremely easy to cause the living environment and the serious social problems, such as population density, traffic congestion, environmental degradation, urban land resources tension, lack of public communication, etc. It impels us to reexamine the relationship between man and nature and society. Therefore, it is inevitable that we must firmly establish the development concept of "socialist ecological civilization", "beautiful China", "harmonious modernization of man and nature", and "ecological priority" in urban construction.

II. RESEARCH SIGNIFICANCE

Decision of the nineteenth National Congress of the party on "speeding up the reform of ecological civilization, building a beautiful Chinese ", plays a significant role in promoting on the implementation of "Launching the opinions on promoting the development of low carbon eco city construction" and "Launching the opinions on the promotion of urban vertical greening in Guangzhou" in recent years. Guangzhou city try to expand the urban greening space through multiple channels, promoting green

Project source: This article is a research project on the construction of the national science and technology think tank in Guangzhou, which is a special research project of Guangzhou's new roof greening pattern, the innovation driven research of "sky garden".

development and solve outstanding environmental problems.

The study shows that the effect of 1 square meters of greening space on the reduction of the heat island effect in the city is equivalent to the greening space of 200 square meters outside the city. If the Guangzhou city of nearly 100 million square meters of the roof is used, it is bound to produce extraordinary benefits for the construction of ecological civilization in Guangzhou. Greening roof grafts and garden planting are widely used at present. Although it can partly reduce the room temperature and save the power of air conditioning and electricity, it has such "bottleneck" problems as high investment, high maintenance cost, and difficult management and maintenance. Sometimes it becomes the "fancy" of the developers to meet the corresponding indicators, and the long-term mechanism of maintenance and promotion is lack.

The use of urban idle roof to create a new roof greening - "sky garden" (urban air landscape complex) is the key to overcome this "short board" and break through the bottleneck.

"Sky garden" with new pattern roof greening and special productive landscape, can effectively curb the Guangzhou ecological land plummeting, expanding the space of urban activity, with the productive functions that are not available in the general urban green space. Viewing and producing are both suitable. It is a part of urban agriculture, which can fill the urbanite's pursuit of the idyllic City, giving full play to the universal function of ecological literacy and systematic thinking education. While using its roof rainwater collection advantage, through the production of landscape, it can provide air reservoir as "sponge city" three-dimensional drainage system for rainwater utilization in Guangzhou City, water ecological restoration, prevention and treatment of urban water logging, water purification ways.

III. RESEARCH STATUS AT HOME AND ABROAD

As early as the 60s of last century, flat greening roofing technology is widely carried out in developed countries. In Germany, Sweden, Britain and the United States, the vertical greening and the vertical greening of the roofs and balconies have been studied and developed quickly. Singapore, Japan and South Korea, with strong economic strength in Asian countries, are also followed. In 1996, St Lawrence Joseph's book "Urban agriculture: the possibility of Roof garden" put

forward the possibility of farming in roof garden. Then, James Pate in the book " Epidermal agricultural Architecture -- advantages, opportunities and challenges ", put forward the concept of epidermal agricultural architecture , which is, making use of the space, balcony, roof, wall and the small green space behind the front house in the vertical direction of the building.

In practice, on the basis of the combination of vertical greening, landscape aesthetic effect and urban agricultural production, many new intersecting ideas have been derived.

For example, the implantation of ecological tillage into residential and commercial buildings is designed to create a living and cultural infrastructure bundled with food production and water circulation systems. The design of the vertical farm project of the school of public health successfully transformed the vertical farm from the virtual concept into a recognized concept of practical value. Other projects, such as Roof garden in the Rockefeller Center in New York, City Green Garden in Detroit, Urban grain Garden in Barcelona and Spain Lafayette, Japan and German civil agricultural garden project etc. , are under construction.

At present, the research on the productive landscape is slow in our country, and the related research is mainly focused on the urban agriculture. In practice, the urban agriculture in the suburbs and rural areas in China is mainly based on high-tech agriculture industry circle and sightseeing agriculture. Its form is single, far away from the city, and it is far from showing the multifunction effect of urban development. Even in recent years, such as Shenyang Construction University, Sichuan Fine Art Institute, China Academy of fine arts, Xiangshan campus and other campus productive landscape practice, but still evaded the original intention of the productive landscape based on the core area of the city and the essential demanding of integrating into the urban lifestyle. The exploration of the integration of the productive landscape in the inner space of the city is less.

According to statistics, China's existing roofing resources are 10 million 950 thousand mu. Roof area is large, wide, which is most in the world. However, the roof, which occupies 80% of the surface area, is in a state of nobody showing any interest in, and the fifth facades of the major cities are filled with grey and barren feelings.

In the 70s of last century, Guangzhou began to carry out the vertical greening plan. In 1997, Guangzhou city promulgated "Regulations on the management of city greening in Guangzhou", which was once considered as the first city law for the greening of roofs in the country. In recent years, Guangzhou has carried out greening experiments and promotion on buildings on both sides of the inner ring road and the residential community across Dongshan District, Yuexiu District, Liwan District and Haizhuqu District, and achieved remarkable results in Liwan District.

Although the "start" is early, the development of Guangzhou's vertical greening still falls behind. According to the data released by Guangzhou Institute of landscape architecture in 2012, the area of roof greening in Guangzhou

accounts for only 0.5% of the total area of the roof, far less than that of Beijing, Shanghai and Shenzhen. In 2015, the construction of vertical greening was pushed to a new climax in the "two meetings" in Guangdong province. Some committee members reintroduced the proposal to promote roof greening in Guangzhou. In July 2015, public bidding for the vertical greening experiment project in Guangzhou has been carried out. In 2017, Guangzhou City Road vertical greening construction project is currently under design bidding.

In response to construction call "beautiful China" of the congress party nineteen meeting, according to the "13th Five-Year" period of the construction of "green ecological beauty of Guangzhou", "city livable environment" guiding ideology, the use of information network technology, modern agricultural technology, modern energy technology, resource recycling technology, modern service technology, create new green roof — "sky garden", are to promote the sustainable productive landscape in Guangzhou.

IV. CONSTRUCTION OF THE URBAN SKY COMPLEX "SKY GARDEN"

This article will stand in the height of the sustainable development of Guangzhou, and carry out a prospective study on the major issue of "green ecology and disease governance in large cities", which involves the economic and social development of Guangzhou, and feasibility analysis of the key measures to create "sky garden" for the roof greening. The theoretical research and practical results of the vertical greening and productive landscape at home and abroad are combed, and Guangzhou is chosen as an object. Guided by theories of vertical greening, urban agriculture, productive landscape, urban planning and sustainable design, a series of coupling studies involving "sky garden" and "big city disease" governance will be carried out.

Based on the location of regional and cultural characteristics of Guangzhou, the design strategy and operation mode of Guangzhou's "sky garden" is proposed innovatively and established initially. A series of research areas in the geographical context such as the site function zone, production efficiency, and artistic performance for "sky garden" are to get depth research and integration.

The selection strategy's formulation should be put in the priority. According to the actual conditions of the limited number and scale of the ecological land in Guangzhou, the spatial distribution features of Guangzhou city greening is analyzed, to seek breakthroughs in a multi-dimensional spatial thinking method. Through the way of building new roof greening "sky garden" to expand the urban green space, we try to increase the leisure activities space of urban residents, and promote the realization of Guangzhou's "ecological priority". We zone the site in a scientific and reasonable way. Productive landscape space with production, leisure, popular science base, service park and so on will be designed according to the proportion of the 50% kinds of vegetables, 30% landscapes and 20% leisure service facilities. Through field experiments and visual design methods, we explore and promote the diversity and sustainable

development of urban landscape, and create the new circular economy mode of Guangzhou sky complex.

Based on the design idea of returning to the “garden city”, we will analyze the geographical and cultural characteristics of Guangzhou, and seek the characteristics of Guangzhou's citizens' cultural identity and the important elements of Guangzhou's regional identification. In order to record and retain the cultural identity of the famous historical and cultural city, Guangzhou and its citizens, the unique business card of the city is designed. We need the landscape in "hard" quality, and the promotion in “soft” culture.

According to the benefit analysis of the economic application, we promote the diversity of urban landscape and create a new circular economy mode of healthy Guangzhou sky complex, testing the productive and economic benefits of sustainable landscape design. We actively explore the operation mechanism of the production landscape market. It includes trying to participate in the urban employment market and formulating a series of incentive policies to guide and control the market in order to achieve a virtuous cycle of the productive landscape market.

From the perspective of policy analysis, we try to use fuzzy theory and other analyzing method to build a non deterministic model, which is based on the benefit analysis of productive landscape marketing, and strive to improve the theoretical level of building greening ecological city and circular economy.

We are searching for the breakthrough point, the productive landscape, as the rescue construction of ecological land in Guangzhou. According to the analysis of the Guangzhou regional and natural conditions, the style of vertical planting with Guangzhou characteristics and rich landscape are expected to formulate with the increasing of green quantity and the improvement of ecological environment. Finally, taking "sky complex" and "sky garden" in the city as the cut-in point and combining landscape greening, commerce, agriculture and south of the Lingnan culture, we try to create a comprehensive urban landscape with Guangzhou's local cultural characteristics. In order to improve the sense of happiness, responsibility and public interaction of the citizens, the affinity and participatory nature of the urban productive landscape design in Guangzhou should be enhanced, and the social interaction space among the citizens increased as well.

Here we design the campus dining room roof as the experimental site, which is analyzed and designed in the following aspects:

First of all, different house owners' requirements for functional zone on the layout of the roof garden will be different. For the general “sky garden”, vegetable planting area should account for more than 50%, and landscape area account for 30%. The remaining 20% can be assigned to the leisure service project. In the process of graphic design, we fully combine the general methods of landscape design and the law of spatial combination, and then plan the layout according to the theme of the garden. The key to the

successful construction of the “sky garden” is the rational layout design, as in student works "Fig. 1":

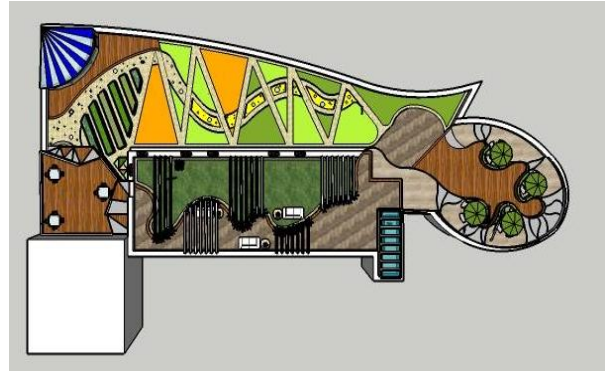


Fig. 1. Layout map of the "sky garden" on the roof of the campus dining hall.

During the facade and the node designing, the entrance area, the leisure area, exhibition area and special service area of “sky garden” are attached great importance to, and distinctive as well. In the process of design, some sketches are aided, and corresponding node is supplied, as in "Fig. 2" and "Fig. 3".



Fig. 2. Student works: Map of the “sky garden” leisure zone on the roof of the campus dining hall.



Fig. 3. Student works: Vertical space design of the “sky garden” leisure area on the roof of the campus dining hall.

In the planning of the special service area, the farming culture is integrated with the concept of environmental protection, and the sky farm is decorated with modern art. The “Soft decoration” of the farm includes vertical greening,

hydroponics, farming devices, deciduous composting, animal home and so on. The deciduous compost area is a special storage area designed at a corner of the sky garden, collecting and storing fallen leaves and fermenting them as natural nutriment in the field. The animal house is similar to the honeycomb house and chicken house of Eagle Street rooftop farm in New York, USA. In our case we plan service area of “water bar”, as in "Fig. 4" and "Fig. 5".



Fig. 4. Student works: Particle map I of special service area “water bar”.



Fig. 5. Student works: Particle map II of special service area “water bar”.

Secondly, in all the landscape design projects, the application of sculpture is an important element, especially to highlight the features of a garden, or create a visual focus. If the weight of the sculpture does not exceed the bearing capacity of the roof, it can be used safely. The building act of San Francisco stipulates that 1% of the cost of public funded buildings must be used for art design. According to this rule, the SWA landscape design company takes sculpture as an important decoration when designing roof garden for the river terminal. Our sky garden also design landscape sketches that highlight the theme of the site, as shown in "Fig. 6", which is a landscape sketch designed for the theme of “1 Meter Garden”.

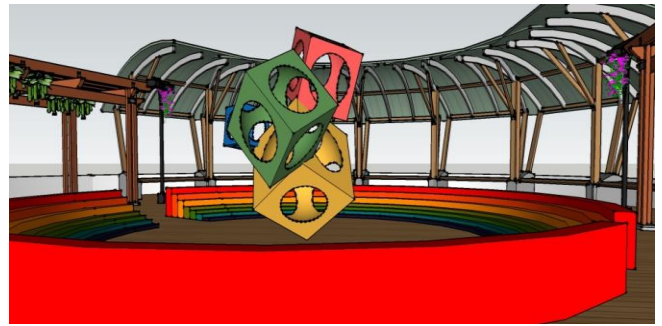


Fig. 6. Student works: the design of the landscape in the roof of the campus dining hall.

Finally, in the allocation of fruits and vegetables, “sky garden” has its particularity in planting. Its planting is mainly divided into two categories. One is vegetable and fruit type planting. The other is landscape planting. A clear awareness of the position, the proportion and the landscape requirements is applied into the two points above. Even the “sky garden” with vegetable planting as its main function should be designed according to some design principles of roof garden to ensure the beauty and appreciation of the “sky garden” over the city. The selection and collocation of vegetables can be considered in the plane structure, the planting area of vegetable color changing, scattered height, etc., as shown in "Fig. 7" and "Fig. 8". In accordance with the basic conditions of agriculture, designers give full play to the creativity and aesthetics, landscape ecology and other aspects of the comprehensive ability to apply knowledge and practice.



Fig. 7. Student works: Design and vegetable & fruit flower.



Fig. 8. Student works: Design of climbing frame in the planting pool and the layout between the border and the landscape chair.

V. CONCLUSION

This article mainly aims at the idle space of the city. It taking the roof of the building as the design object and combining the concept of sustainable design, innovatively proposes a new viewpoint of "putting the productive landscape into the idle space on the roof of Guangzhou", and explores a new urban sky complex pattern. Restructuring the design of new dimension of urban landscape, we takes advantage of the integration research on vertical planting, urban agriculture, roof rainwater collection of sponge City, urban ecological disease and humanistic governance. We propose that urban "sky garden" is a new idea of the coupling product of "roof greening, productive landscape and urban agriculture".

Under the background of deep development in the city, it is significant and urgent for the three strategies of "urban agriculture, urban landscape and productive landscape commercialization" to integrate into the urban roof greening strategy. In order to enhance the theoretical foundation of Guangzhou's "lost space" and explore the construction method of the sky landscape complex in Guangzhou's core area with the help of interdisciplinary theoretical research, we hope to provide some useful references for other cities' productive landscape construction.

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