

Study on the Second Ground Landscape in the Urban Center - Taking the Central Axis of Tianhe District in Guangzhou as an Example

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Abstract:

With the acceleration of urbanization, especially in the context of increasing space resource shortage and ecological environmental pressure in the central area of megacities, the second ground landscape design, as a supplement to the public activity needs of the “first ground”, is an important means to effectively make up for the problem of insufficient public space in the central urban area. Taking Tianhe District of Guangzhou as an example, the study analyzes the application practice of the second ground landscape design in the urban center through eight typical cases such as Canton Tower Square, Huacheng Square and Parc Central on the central axis. The reasonable use of design strategies such as spatial form, plant configuration and landscape aesthetics has been obtained, which effectively improves the spatial function, ecological benefits and visual beauty of the second ground in the urban center with limited space, and provides strong support for the green and sustainable development of the city.

Keywords:

City Center, Second Ground, Design Strategy

1. Introduction

In 2014, General Office of the State Council issued a document that further clarified the classification standards for megacities and super-large cities, emphasizing the core position of these cities in the national urban system and their important task of achieving high-density urban development and high-quality living environment [1]. However, in the context of particularly acute conflicts between population, land and environment, how to expand the development ideas of greening and extend from ground greening to multi-dimensional space has become an inevitable choice for improving the ecological environment quality in the urban center [2]. At the same time, urban centers should avoid relying on “large-scale demolition and construction” to expand green space, and instead explore sustainable strategies guided by “micro-renewal and deep integration” to improve the community environment and stimulate

urban vitality through small-scale, low-cost precision interventions [3]. In 2023, The People's Government of Guangzhou City proposed that the principle of "adapting measures to local conditions and building only when appropriate" should be adhered to, and the diversified development of three-dimensional greening functions should be explored. Starting from plant selection, greening forms and safety regulations, a three-dimensional greening implementation guide should be formulated to promote the construction of functional, characteristic and functional greening spaces, and combine them with various types of green spaces, parks and other flat greening to improve the city's greening network system. According to the plan, by 2025, the city should add 200,000 square meters of three-dimensional greening, and by 2035, the cumulative new area will reach 750,000 square meters [4].

1.1. Related research and current status

In response to the lack of space resources in foreign cities, Germany issued the "Guidelines for Roof Greening" in 2002. At present, Germany has more than 100 million square meters of green roofs, accounting for more than 50% of the green roofs, and has achieved remarkable results in promoting sustainable urban development [5]. Singapore started with the "Garden City" movement and gradually proposed the concept of "City in a Garden". It actively expanded facade and roof greening, increasing the green coverage rate from 35.7% to 46.5% in 20 years [6]. In addition, some more innovative concepts include Japan's "urban metabolism" theory, the "biophilic city" concept advocated by the United States, and Spain's exploration of the "urban acupuncture" strategy. At the same time, relevant foreign research also emphasizes the multi-dimensional value of the second ground space in responding to climate change and urban ecological reconstruction. It is believed that it not only helps buildings save energy and fix carbon, improves the efficiency of rainwater recycling, but also demonstrates economic sustainability in commercial scenarios [7,8,9].

In the context of urban renewal and ecological civilization construction, China's attention to the second ground space has gradually increased, and related explorations are showing a trend of coordinated development from policy promotion to theoretical research and practical application. On the one hand, we explore the path of promoting the integration of urban three-dimensional greening and ecological space construction with a systematic policy system, taking megacities such as Shanghai and Shenzhen as examples. The former coordinates the layout of three-dimensional greening in the overall planning and detailed planning, and promotes its coordinated development with ground greening [2]; The latter uses the vertical greening conversion mechanism to increase the green volume and ecological benefits per unit area [10]. On the other hand, people have begun to pay attention to the complex functions and ecological value of the second ground space. Relevant studies have pointed out that it has significant environmental benefits in improving air quality, regulating microclimate, saving energy and reducing emissions, and has also gradually expanded to a comprehensive evaluation of its economic and social functions [11,12].

In summary, foreign countries focus on proposing multi-dimensional greening development paths from the aspects of ecological complexity, spatial integration and environmental psychology, and have established relatively mature policy systems and technical standards, providing solid support for the diversified development of the second ground space; China is more focused on the organic integration of green space in high-density built-up areas through refined governance, micro-scale intervention

and low-cost strategies, providing directional guidance and policy support for the localized exploration and systematic development of the second ground space.

1.2. The connotation of the second ground space

The second ground is defined relative to the first ground. In the context of increasingly tight urban public space and insufficient green view rate, the “second ground” can serve as a supplement to the public activity needs of the “first ground”, and can effectively make up for the lack of public space in the central city due to high construction density and limited available land. Its “non-ground” characteristics enable it to activate the corner space and the three-dimensional interface of the building, and enhance the layering and diversity of the public space.

Therefore, the essence of the second ground landscape is the “non-ground public space” extended through the three-dimensional space under the background of tight urban space resources. It is a supplement to the public space and can increase the interest of the public space in the city center. Its design concept is to develop in multiple dimensions, which is an extension and reconstruction of the traditional ground green space in multi-dimensional space [13].

2. Design Object and Case Analysis

2.1. Study subjects

Second, in a limited urban environment, ground space can provide new possibilities for the expansion of green activity venues and the alleviation of ecological pressure through various forms, which are mainly reflected in (Table 1): ① Roof gardens and other forms in the design of building top space are a multidisciplinary research field, which can not only greatly improve the water and thermal environment of the city, but also effectively enhance the biodiversity of the urban ecosystem and improve the urban living environment [14]; ② Vertical interface space, especially vertical garden buildings, can integrate natural biological elements into the urban landscape, improve the city’s green view rate, and alleviate the impact of the urban heat island effect, providing a new path for improving the quality of the urban environment [15]; ③ The sunken space and ④ the cantilevered connecting space can serve as extensions of the urban space, enhancing the connectivity and accessibility between different functional areas, shortening the movement lines, and improving the efficiency of spatial flow. By integrating landscape design, these spaces can shape an urban space model that is both adaptable to the environment and compatible with the ecology, providing citizens with a smoother and more pleasant urban experience.

Table 1. Classification of research objects of the second ground landscape design.

Category	Representative Cases	Representative Space	Common Forms	Key Features
Building top space	 Canton Tower Square Roof Garden	Building roofs and podium tops	Rooftop farms, rooftop gardens, green roof systems	Ecological regulation, increasing green space and public activity space

Vertical interface space	 Parc Central Shopping Center	Building facades, walls, vertical traffic nodes	Vertical green walls, stepped landscapes, street slope gardens	Beautify the urban interface, increase green view rate, save energy and reduce emissions, and alleviate the heat island effect
Sunken space	 Canton Tower Square Sunken Space	Underground courtyard, sunken square, underground light well	Sunken green space, lighting courtyard, rainwater garden	Optimize traffic experience and flash exhibitions
Cantilevered connecting space	 GT LAND PLAZA cantilever platform	Sky corridor system, overhead platform, bridge space	Corridor garden, green corridor on bridge, urban balcony, and greening of second-floor platform	Optimize the traffic experience

As citizens’ attention to high-quality living space continues to rise, traditional green spaces can no longer meet their daily needs for accessibility and nearby stay. At the same time, urban streetscape is an important factor affecting the emotions of urban residents. Studies have shown that higher green is associated with positive resident emotions [16], vertical greening is more effective in alleviating the sense of oppression than opening up the field of vision [17]. The second ground, with its flexible and diverse forms, can be embedded into the urban texture in a visibly green manner, creating a green public space that is friendly, accessible and full of life. It can effectively enhance the vitality of the city and improve the diversity and livability of the urban space.

2.2. Case Studies

In order to explore the application and effectiveness of the second ground landscape in the city center, this paper takes Guangzhou as a typical case city and selects multiple types of practices such as representative building top surfaces, longitudinal interfaces, sunken spaces and cantilever connections along its axis for analysis.

2.2.1. Canton Tower Square

As an important part of Guangzhou’s landmark buildings, Canton Tower Square (Figure 1) exhibits rich spatial hierarchy and functional complex characteristics in the vertical direction. The second ground landscape type in this area mainly includes a roof garden on the top of the building.

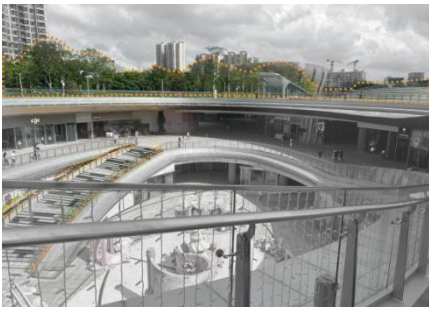


Figure 1. The second ground landscape of Canton Tower Square.

As the most open and accessible green space in the square (Figures 2 , Figures 3), the rooftop garden provides visitors with a good rest and viewing experience through height difference guidance and open sight lines. The garden has a variety of plant configurations, and at the same time, with landscape facilities such as seats, hydrophilic platforms, sunshade rest pavilions (Figure 4) and a complete lighting system and guidance system, it forms a relatively complete green stay space.



Figure 2. Rooftop Garden at Canton Tower Square.



Figure 3. Canton Tower Square rooftop garden walkway.

Table 2. Main plant configuration of Guangzhou Tower Square.

Category	Name	Growth Characteristics	Artistic Features
Shrub	<i>Syzygium hancei</i>	Light-loving, semi-shade-tolerant, slightly drought-tolerant	The new leaves are bright red, and the mature leaves are glossy green. They can be used as landscape walls and partitions to divide spaces and soften boundaries.
	<i>Fagraea ceilanica</i>	Light-loving, shade-tolerant, slightly drought-tolerant	The flowers have a fresh fragrance and are suitable for placement next to leisure seats to enhance the comfort of the space.
	<i>Loropetalum chinense</i>	Light-loving, semi-shade-tolerant, drought-tolerant	The leaves are purple-red and can be planted as a color block or a low hedge to guide the line of sight.
	<i>Rhapis excelsa</i>	Likes warm and humid, semi-shady environment, strong shade tolerance	It has an elegant posture and is suitable as a corner embellishment or visual barrier to divide areas.
	<i>Aglaia odorata</i>	Likes sun, tolerates partial shade, relatively drought-tolerant	It is suitable as a small shrub, adding fragrance and enriching the layers.
	<i>Duranta erecta</i>	Sun-loving, drought-tolerant	The edges of the mature leaves are golden yellow, with a strong color contrast. It can be used as a decoration on the edges of flower beds to enrich the layers.

In the landscape design of the rooftop platform of Canton Tower Square, the selection of plants comprehensively considered ecological suitability, landscape expression and feasibility of later maintenance and management (Table 2). The plants selected in this case basically have strong drought resistance, light-loving, wind resistance and disease and pest resistance, with a long overall growth cycle and extensive management, which meets the basic requirements of roof greening for lightweight and low maintenance.



Figure 4. Plant configuration effect around the rest pavilion in Guangzhou Tower Square.

2.2.2. Huacheng Square

The second ground landscape design of Huacheng Square is mainly reflected in the layout of the street-side raised buffer green belt landscape (Figure 5). This green belt not only effectively divides the square space and the surrounding diversified building functional areas, forming a natural and layered transition zone, but also provides pedestrians with a comfortable resting space, enhancing the affinity and accessibility of the space. At the same time, the slope landscape design facing both sides of the square (Figure 6) is very distinctive, using rich plant combinations and terrain changes to create a vivid green landscape, which not only enhances the visual effect of the overall landscape, but also optimizes the ecological function.



Figure 5. The elevated buffer green belt landscape on the Huacheng Square street.



Figure 6. Slope landscape design facing both sides of the square.

Table 3. Main plant configuration of Huacheng Square street landscape.

Category	Name	Growth Characteristics	Artistic Features
Shrub	<i>Ruellia simplex</i>	Sun-loving, drought-tolerant	The flowers are bright blue or purple and are suitable as a slope cover plant or edging decoration.
	<i>Heptapleurum arboricola</i>	Strong shade tolerance and relatively drought tolerant	The leaves are shaped like goose feet and are suitable as slope covering plants or vertical greening materials.

	<i>Excoecaria cochinchinensis</i>	Prefers semi-shade, strong shade tolerance, relatively drought tolerant	The mature leaves are dark green on the front and purple-red on the back, with a strong color contrast, making them suitable as edge decoration plants to enrich the layers.
	<i>Hibiscus rosa-sinensis</i>	Light-loving, heat-tolerant, drought-tolerant	The flowers are full in shape and rich in color, making them suitable as embellishments on slopes or landscape node plants to enhance the color level.
Herb	<i>Asparagus cochinchinensis</i>	Light-loving, drought-tolerant, cold-tolerant	The leaf-like branches are slender and soft, lush and green, with an elegant posture. They are suitable as background plants for slope edges or flower borders to soften the edges.
	<i>Nephrolepis exaltata</i>	Prefers semi-shade, relatively shade-tolerant	The new leaves curl and unfold, the mature leaves are slender and drooping, and the pinnate leaves are emerald green, making them suitable as plants for slope edges or vertical greening.
	<i>Bougainvillea spectabilis</i>	Light-loving, drought-tolerant, heat-tolerant	The bracts are rich in colors and have a variety of color variations. They are suitable as decorative plants on slopes or facades to highlight the visual focus.

The plants of the street-side raised buffer green belt and slope landscape need to have good environmental adaptability and ornamental function (Table 3). Most of these plants are drought-resistant and waterlogged, and can adapt to a variety of light conditions from full sun to semi-shade, forming a layered three-dimensional landscape effect. In a complex urban environment, they grow stably and require low maintenance, which can effectively reduce the cost of later management. In addition, the plants of the slope landscape (Figure 7) have rich ornamental value, such as colorful leaf color, bright flower color and long flowering period, which not only enhances the visual experience on both sides of the square, but also enhances the ecological value of the green belt.



Figure 7. Effect of landscape plant configuration on the slope of Huacheng Square.

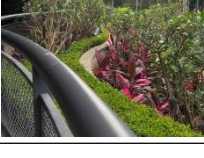
2.2.3. GT LAND PLAZA

The highlight of the second ground landscape design of GT Land Plaza (Figure 8) is mainly reflected in the fine construction of the vertical interface space. This case makes full use of the three-dimensional space resources and extends the green from the ground to the vertical dimension through a variety of facade greening techniques, forming a rich visual level and spatial experience, showing the multiple potentials of the second ground space in visual softening, ecological regulation and spatial vitality stimulation (Table 4).



Figure 8. The second ground landscape of GT LAND PLAZA.

Table 4. Second ground type and main plant configuration of GT LAND PLAZA.

Type	Form	Distributed	Picture	Plant configuration
Vertical interface space	Vertical Cylinder	outdoor		<i>Heptapleurum arboricola</i> , <i>Ruellia simplex</i> , <i>Tradescantia zebrina</i>
		interior		
	Staircase facade	outdoor		<i>Bougainvillea glabra</i> , <i>Campsis grandiflora</i>
		interior		<i>Epipremnum aureum</i> , <i>Alocasia odora</i> , <i>Heptapleurum heptaphyllum</i>
	Store facade	/		<i>Epipremnum aureum</i> , <i>Alocasia odora</i>
	Elevation	/		<i>Bryophytes</i>
	Building facade	/		<i>Campsis grandiflora</i> , <i>Epipremnum aureum</i>
Cantilevered connecting space	Cantilever platform	/		<i>Campsis grandiflora</i> , <i>Cordyline fruticosa</i>

2.2.4. Parc Central

The practice of the second ground landscape design of Parc Central (Figure 9) is concentrated on the vertical interface greening and the multi-dimensional creation of the roof garden (Table 5). This case uses a large area of greening treatment on the building facade. Although the plant species are relatively small, the overall greening effect is significant through the strategy of dense planting and concentrated coverage, which effectively alleviates the sense of oppression brought by the building volume, enhances the greenness of the urban facade, and shows the comprehensive potential of the second ground space in ecology, functionality and aesthetic expression.

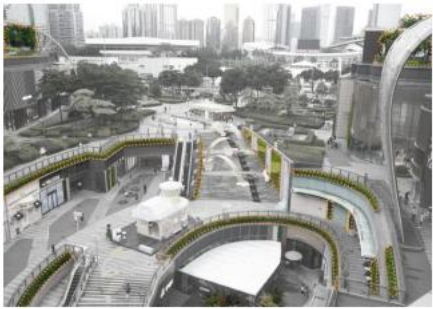


Figure 9. The second ground landscape of Parc Central.

Table 5. The second ground type and main plant configuration of Parc Central.

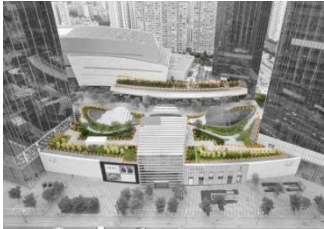
Type	Form	Distributed	Picture	Plant configuration
Vertical interface space	Building facade	/		<i>Nephrolepis exaltata</i> , <i>Heptapleurum arboricola</i>
	Store facade	/		<i>Epipremnum aureum</i>
	Staircase facade	/		<i>Excoecaria cochinchinensis</i> , <i>Heptapleurum arboricola</i> , <i>Nephrolepis exaltata</i>
Cantilevered connecting space	Cantilever platform	/		<i>Heptapleurum arboricola</i>
Building top space	roof garden	Facade wall		<i>Heptapleurum arboricola</i> , <i>Nephrolepis exaltata</i>
		Leisure Seats		<i>Nephrolepis exaltata</i> , <i>Plumbago auriculata</i> , <i>Chlorophytum comosum</i> , <i>Impatiens hawkeri</i>

		Decorate bonsai		<i>Nephrolepis exaltata</i> , <i>Duranta erecta</i> , <i>Plumbago</i> <i>auriculata</i> , <i>Cordyline</i> <i>fruticosa</i>
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2.2.5. Other related cases

In addition to the core cases, Guangzhou has many projects that explore the ecological and functional potential of the second ground through rooftop and three-dimensional greening. The following selects several typical cases and briefly analyzes their forms and strategies to show the city’s diverse practices in different scenarios. (Table 6).

Table 6. Second ground landscape case in Tianhe District, Guangzhou.

Case	Second Ground Form	Design Strategy
 Taikoo Hui Guangzhou	Roof greening, overhead platform greening	Taikoo Hui connects the rooftops with multiple terraces, sky terraces and the ground, forming a rich spatial hierarchy and a composite utilization pattern. Combining weather-resistant plants with simple landscapes, a comfortable sky garden is created, which enhances the architectural linkage and overall ecological benefits.
 37 Interactive Entertainment Global Headquarters Building	Roof greening, overhead platform greening, vertical greening	The "360° spiral three-dimensional greening" connects the roof, overhead floor and platform to construct a multi-level greening system, combining weather-resistant plants and shading facilities to create a three-dimensional space that combines ecology and leisure.
 Guangzhou Pengrui No. 1	Roof greening, overhead platform greening	Through the concept of "defining space with plants", the sky garden is reshaped on the basis of the original hard structure, weather-resistant plants are used to divide functional scenes, a layered green island space is created, and details and color design are used to enhance the visual and emotional experience.
 Vanke Cloud	Green roof	Through the staggered layout of multiple building blocks, a continuous roof platform system is formed. Its stepped terraced shape not only responds to the low scale of the urban village on the west side, but also achieves a dialogue with the surrounding environment through flexible transition in space.

These cases integrate space and expand green space in different forms, strengthen ecological and aesthetic functions, and demonstrate the potential of the second ground

as a medium for urban three-dimensional landscape. They promote the in-depth expansion of urban landscape from two-dimensional to three-dimensional and from ground to three-dimensional.

3. Results and Discussion

3.1. *Diversification of the second ground landscape space*

In the city center, the second ground landscape design is an important means to make full use of the facades and roof spaces of buildings to increase the diversity and functionality of green space. For vertical spaces with limited space, the diversity of spatial forms can be fully utilized to enhance the second ground landscape design. According to the characteristics of different locations and spatial functional requirements, appropriate design techniques can be flexibly selected to achieve a landscape layout that is adapted to local conditions. For example, in the two cases of GT Land Plaza and Parc Central, the space was effectively activated through the multi-dimensional use of the vertical interface space, using stepped landscapes, vertical green walls and other forms in different indoor and outdoor areas, and using a variety of landscape design techniques. Although the types of plant configurations are relatively limited due to environmental conditions, the differentiated and adaptive landscape expression effectively improves the spatial hierarchy and green coverage rate, creating more green ecological space for the city.

3.2. *Suitability of Second Ground Landscape Plants*

Paying attention to the suitability of plants in the design of the second ground landscape is the key path to maximize ecological benefits and promote green and sustainable urban development. Reasonable selection of plant species that adapt to specific habitat requirements ensures their stable growth and development in their respective spaces, thereby forming a plant community with a reasonable structure, rich layers and seasonal changes.

In the space on the top of the building, due to the strong light, strong wind and thin soil layer, it is advisable to choose plant varieties that are drought-tolerant, light-loving, wind-resistant and resistant to diseases and pests. Such plants as *Loropetalum chinensis*, *Forsythia suspensa*, and *Aglaia odorata* have the characteristics of long growth cycle and low maintenance requirements, which are suitable for the lightweight requirements of roof greening; For vertical interface spaces, such as green walls or vertical greening, plants with good climbing ability, strong adaptability and drought tolerance should be selected, such as *Campsis grandiflora*, *Heptapleurum arboricola*, *Nephrolepis exaltata*, etc., to ensure their stable growth in limited space and form a good landscape effect; In the design of some street slope landscapes, plants should not only have good ecological functions, but also have high ornamental value, such as *Hibiscus rosa-sinensis*, *Gomphrena globosa*, *Begonia cucullata*, etc., to enhance the beauty of the street and the walking experience, thereby enhancing the visual appeal of the entire urban public space.

This plant configuration method, which is tailored to local conditions, can not only enhance the stability of the ecosystem, but also improve the visual beauty and spatial experience of the landscape.

3.3. *The aesthetics of the second ground landscape layout*

In high-density urban centers, green space design should not only focus on ecological benefits, but also consider the aesthetic expression of the landscape to achieve the dual goals of spatial function and visual enjoyment. For example, Huacheng Square cleverly separates public space from surrounding buildings through the design of a raised buffer green belt, while also guiding the flow of people through the landscape green belt, thereby enhancing the interactivity and aesthetics of the space. Parc Central uses a variety of landscape elements, such as landscape seats, wooden platforms, and facade walls, to organically combine spatial functions with artistic effects, creating a resting place that is both practical and aesthetically valuable.

At the same time, aesthetics is not limited to the surface treatment of form and color, but can also be reflected in the use of “white space”, the restraint of scale, or the integration and extension of architectural language. Various green forms are organically unified with actual functions through diversified landscape techniques, fully reflecting the combination of functionality and aesthetics, so that each landscape can meet people’s visual needs and comfort needs at the same time.

4. Conclusions

As an important means to improve the quality of urban ecological environment, the second ground landscape design is of great significance in high-density urban centers. This article sorts out the relevant case analysis on the central axis of Tianhe District, Guangzhou, and can draw relevant strategies for the second ground landscape design. In specific design practice: ① The diversification of spatial forms provides more possibilities for limited urban space. The use of vertical interfaces and roof gardens effectively makes up for the lack of ground greening. ② The suitability of plants can ensure the stability of the ecosystem while enhancing the visual beauty and spatial experience of the landscape. ③ The landscape layout that combines functionality with aesthetics not only enhances the diversity of urban landscapes, but also optimizes the use experience of space, enabling residents to enjoy a better quality of life.

Therefore, the application of the second ground landscape design in the urban center can not only alleviate the urban ecological pressure, but also enhance the sense of gain and happiness of urban residents. Through innovative design ideas and scientific planning, it can provide a sustainable and green space development path for megacities and super-large cities, and promote the green and sustainable development of cities.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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