

Study on the Inheritance of Urban Landscape Art from the Perspective of Microclimate - Taking *Yu Yin Shan Fang* in Guangzhou as an Example

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Abstract:

Taking the positive influence of Lingnan gardens in the ecological practice of Chinese classical gardens as the research background, this paper discusses the related influence of microclimate on human behavior in *Lingnan* gardens, refines the design rules and influencing factors, and aims to better apply it to modern landscape design. Taking *Yu Yin Shan Fang*, one of the four representatives of Lingnan gardens in Guangzhou, as the research object, through the method of structured observation, the paper emphatically analyzes the environmental characteristics of the site, the spatial layout and the perception of the viewer, and explores the spatial design strategy under the influence of microclimate. obtained three research results. First, *Yu Yin Shan Fang* can create comfortable space under various natural conditions in the hot climate. No. Second, the unique Lingnan architecture can effectively reduce the temperature. Third, although the spatial scale of Lingnan garden is small, the space and space are connected and open, forming a benign microclimate.

Keywords:

Microclimate, Yu Yin Shan Fang, Structured Observation, Garden Space

1. Introduction

Microclimate changes with time of day and seasonal changes [1]. Is the climate of a small local area [2]. The diversity of microclimates is combined with the diversity of natural geographic conditions [3]. It is determined by the underlying structural characteristics and occurs near the ground within 1 km of the horizontal range below 100 meters [4]. The environmental characteristics of microclimate refer to the characteristics of climate change in a small range of soil, air circulation, rain, solar radiation, terrain, and vegetation [5]. It is a climate close to the surface space, and it is the wind, light, temperature and humidity conditions around the building, above the ground and other places [6]. In addition to the influence of the regional environment, the microclimate is also susceptible to human interference [7].

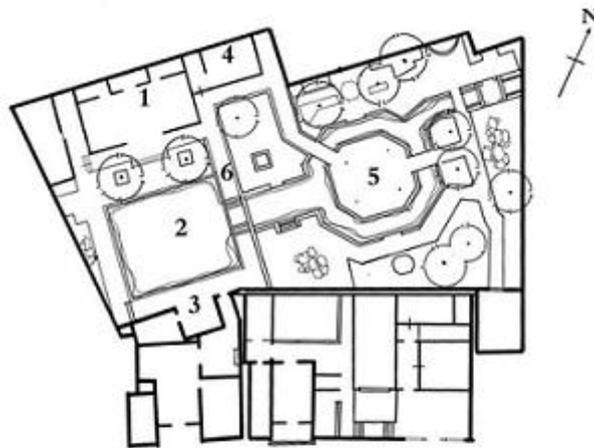
2. Materials and Methods

2.1. Case Overview

The location of this case is *Yu Yin Shan Fang*, located in *Panyu District*, *Guangzhou City*, *Guangdong Province*, with coordinates 113.395709n and 23.011378e. *Guangzhou* is located in southern China. Subtropical monsoon climate characterized by humidity, heat, and rainfall (Table 1 [8]). The total area of the *Yu Yin Shan Fang* is about 1598 square meters. It is located south to the north and divided into east and west. It was built in the six years of *Tongzhi* in the *Qing Dynasty* and has a history of 152 years. With *Shunde Qinghui Garden*, *Foshan Liangyuan*, *Dongguan Keyuan* collectively known as *Guangdong four famous gardens*. The *Yu Yin Shan Fang* inherits the small and exquisite features of *Lingnan gardens*. Although the interior layout is compact but well-organized, it fully reflects the unique style and superb gardening art of ancient *Lingnan garden buildings*. (Figure 1, Figure 2).



Figure 1. Aerial photo of Yu Yin Shan Fang.



1, Shen Liu Tang 2, Pond 3 Lin Chi Bie Guan
 4, Wo Piao Lu 5, Linglong waterside pavilion
 6, Huan Hong Kua Lv Qiao

Figure 2. Plan of Yuyin Mountain House.

Table 1. List of Meteorological Elements in Panyu District 2016-2018.

year	Mean temperature (°C)	Temperature anomaly	Maximum temperature (°C)	Minimum temperature (°C)	Precipitation (mm)	Percentage precipitation anomaly (%)	Hours of sunshine (hours)	Percentage of sunshine anomaly (%)
2016	23.3	0.7	38.4	2.7	2613.8	56	1472.4	-10

2017	23.6	1	39.7	6.8	1793.7	7	1723.5	6
2018	23.5	0.9	37.2	4.4	2244.7	34	1582	-3

2.2. Selection of Study Area Characteristics

According to the conditions of environmental comfort, study the characteristics of different natural climate changes such as wind direction, water, sunlight, plants and other microclimate conditions, and the spatial design conditions of the underlying surface and buildings. Multiple observation points were selected in *Yu Yin Shan Fang* according to different influence conditions (Figure 3).

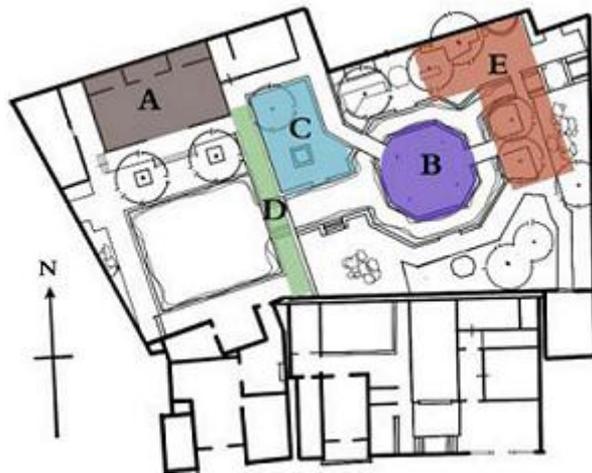


Figure 3. Plan view of test point location.

2.3. Research Methods

This study uses microclimate analysis and structured observation methods to obtain landscape space design strategies under the microclimate of *Lingnan* gardens. Collect relevant documents about "*Lingnan* gardens" and "*microclimates*" through *CNKI*, *Elsevier* and other literature websites. Combined with the observation of *Yu Yin Shan Fang*, study the role of microclimate in *Lingnan* gardens, and learn and inherit the design elements of ancient gardens in the Guangdong, Hong Kong and Macau Bay Area.

2.3.1. Structured Observation

In order to investigate the effect of microclimates on the *Yu Yin Shan Fang*, the field survey and structured observation method were used to study the observation records. The structured observation method was proposed by Dr. Visas Mehta, School of Architecture and Community Design, University of South Florida [9], which is a researcher's observation from the perspective of the user, through micro-environmental characteristics (wind direction, temperature, plants, space and other information or other factors), behavioral environment (stay time, rest, snacks, facilities, etc.) Make observations and record [10].

3. Results and Discussion

3.1. Microclimate analysis of *Yu Yin Shan Fang*

Garden space: *Deng Qisheng* [11] In "*Panyu Yu Yin Shan Fang Layout Features*", *Lingnan* is a hot and humid climate, the building requires transparency, and indoor

and outdoor spaces are often integrated into one another and penetrate each other. And *Xiao Yiqiang* and others [12], *Hui Xingyu* [13], *Xu Ning* and others [14], *Li Juanjuan* [15] and *Tan Yigang* and others [16] When studying the characteristics of Lingnan architecture, they have concluded that the transitional spaces such as corridors and patios in *Lingnan* buildings, through their roofs, play a role in shading the walls of the main rooms, effectively reducing the hot outdoor climate to the main living spaces in the interior. The conclusion is that the spatial layout is tight and the ventilation is used to achieve the requirements of heat dissipation and dehumidification. Therefore, the small-scale space of the *Lingnan* garden is established based on climatic conditions. Compared with Suzhou gardens, the spatial scale is small, the spatial layout is tight, and the connectivity is strong.

Natural factors of microclimate: In 1974, Professor *Nj Rosenberg* said that water has the characteristics of low reflection, heat absorption and high transmittance. Professor *Eh Romanova* concluded that heat is the decisive factor in the landscape, and the amount of heat will affect the terrain environment. In 2008, *Li Shuyan* and others [17] concluded that the temperature near the water body is the lowest, and the area and layout of the water body are important factors affecting the microclimate. The larger the area of the water body, the more it will affect the microclimate in the space. Large, increasing the wind velocity of the ground surface also increased. *Yang Yunyun* [18] briefly analyzed the psychological characteristics of people's water-loving and hydrophilic properties in "*Regulation Design of Microclimate Factors in Urban Landscape Ecology*". *Xue Sihan* and others [19] conducted experiments in 2014 and concluded that when the temperature rises, the air humidity above the water body is higher than the air humidity in other areas, and the temperature decreases, the gap between the two gradually narrows. The rainfall of Yuyin Mountain House occurred in June at most, and at least in December (Table 2), and the role of water bodies in Lingnan gardens is extremely important. Therefore, the establishment of ponds in Yuyin Mountain Houses has the function of water storage. In the middle of the building, when the temperature is highest in July, the solar thermal energy can be used to evaporate the water body to form water vapor and enter the room to reduce the temperature.

Liang Mingjie's [20] research in 2012 concluded that the core of the architectural layout of Lingnan lies in climatic factors, and pays great attention to the influence of orientation on ventilation. Southeast wind in summer and northerly wind in winter. The building layout is mostly south or southeast. Windows to make full use of the wind direction to solve the ventilation problem. East-west walls are used to prevent solar radiation heat. Because the southeast winds in the *Lingnan* area in summer, the interior windows of the *Yu Yin Shan Zhuang* are mostly north-south, so when the airflow enters the garden, the water vapor above the pond is brought into the room, and the hot air mass originally located above the room is taken out go outdoors and lower the indoor temperature so that people don't feel hot and humid.

There are many plants in the garden, which are mainly concentrated on the east and south sides of the garden. In addition to the beautiful effects of plants, the plants also have the effect of improving microclimate and environmental quality. *Li Fei* [21] compared the other microclimate factors in the study to obtain the garden. The conclusion that plants improve microclimate is the most environmentally friendly and economical way to take the path of sustainable development. *Yang Yunyun's* [22] research on *Lingnan* garden plants has found that plants can neutralize the heat radiated by sunlight, also provide insulation for buildings and soil and reduce

fluctuations in temperature, creating an independent passive microclimate space. The air filtering effect and its noise reduction effect make the entire garden fresh and pleasant. The photosynthesis of plants is transformed into oxygen-generating functions, which can improve the garden environment. (Figure 4).

Table 2. Statistics of monthly elements of Panyu District in 30 years (1981-2010).

Month	Precipitation (mm)	Mean maximum temperature (°C)	Mean temperature (°C)	Mean minimum temperature (°C)
January	44.4	18.7	13.9	10.7
February	71.1	19.2	15.2	12.5
March	93.4	21.8	18.5	15.4
April	184.6	26	22.4	19.7
May	286.8	29.8	25.8	23
June	318.6	31.7	27.8	25
July	238.2	33.2	28.9	25.9
August	233.8	33.2	28.8	25.7
September	194.4	31.8	27.5	24.4
October	68.7	29.3	24.7	21.3
November	38.4	25.1	20.1	16.5
December	29.3	20.8	15.5	11.8

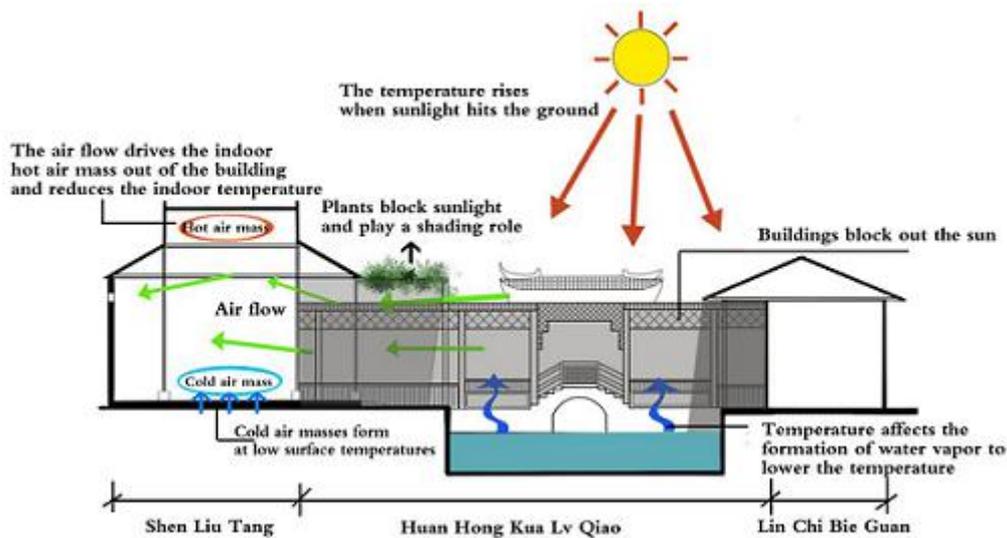


Figure 4. Analysis of the microclimate elevation of the Yuyin Mountain House.

3.2. Structured Observations

Observations on weekdays and weekends show that the micro-environmental characteristics and behavioral environment of the observation points are different, and people's activities at the observation points are also different (Table 3, Table 4, Figure 5). Sort comfort from high to low through the experience of the five observation points and the summary of the test results.

Table 3. Summary table of structured observation behavior of observation points.

No. of test point	Measuring point position	diet	sit	Stop watching	to chat with	Watch the mobile phone	Photograph	Film and television works
A	Shen Liu Tang		√	√	√	√	√	√
B	Linglong waterside pavilion		√	√	√	√	√	√

C	Space in front of Wo-piao Lodge	√	√	√	√	√	√	
D	Huan Hong Kua Lv Qiao	√	√	√	√	√	√	√
E	Linglong waterside pavilion North		√	√	√	√	√	√

Table 4. Summary table of structured observation behavior data of observation points.

No. of test point	Test point location	male	Female	Children, teenagers	Youth	middle age	old age	die t	Stay and appreciate	sit	chat	Watch the mobile phone	Photograph
A	Shen Liu Tang	69	91	10	76	58	17	0	86	29	35	9	52
B	Linglong waterside pavilion	91	86	2	108	48	19	0	49	79	56	32	59
C	Space in front of Wo-piao Lodge	10	22	5	5	14	8	2	20	4	12	5	12
D	Huan Hong Kua Lv Qiao	46	72	5	52	29	30	6	71	52	29	20	40
E	Linglong waterside pavilion North	56	73	8	56	26	35	0	68	5	19	8	59

Simply passing the test points is not included in the observation data. **Linglong waterside pavilion** is also known as the "octagonal pavilion". Surrounded by water and eight windows on eight sides, the air flow is smooth. Plant a variety of plants around. With all natural factors affecting microclimate, the temperature in the pavilion is lower than outside. *Linglong water pavilion* has 13 seating facilities for visitors to rest, so *Linglong water pavilions* have the largest number of people to stay, and 79 people sit here to rest during the observation data, which is the most comfortable test point.

Shen Liu Tang near the pond, the south transparent, windows on the north wall can induce wind to reduce temperature and humidity. There are 12 seats to provide rest, but the windows of the north wall of the deep willow hall are not open, and the ventilation effect is lower than that of the *Linglong water pavilion*, so it's a slightly more comfortable test point .

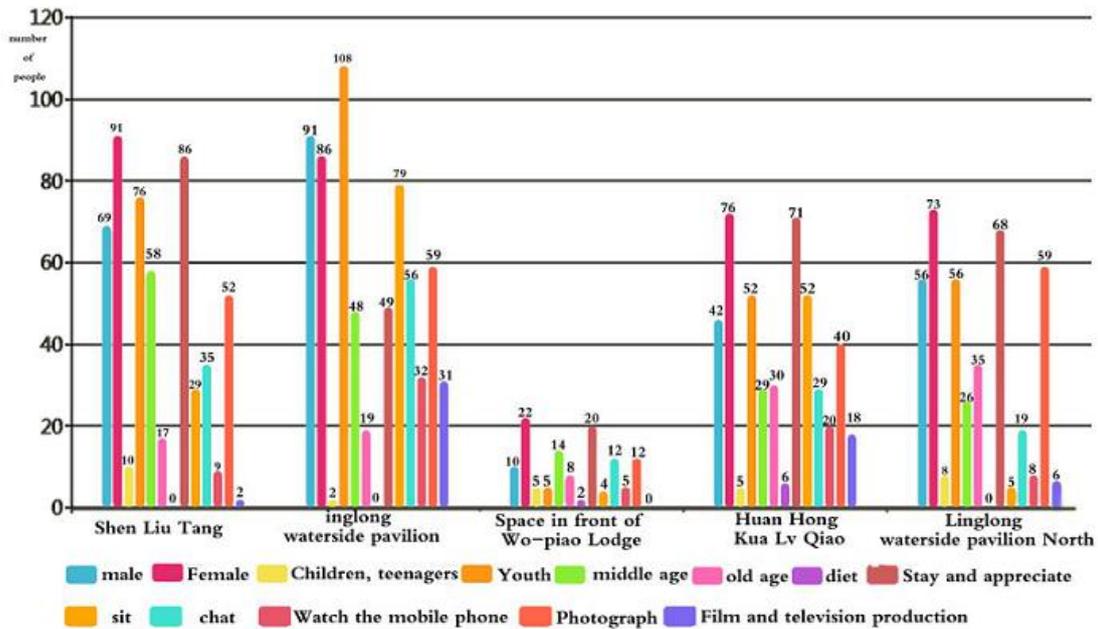


Figure 5. Histogram of structured observation behavior data of observation points.

There are many plants in the north of *Linglong waterside pavilion*, which are planted on both sides of the road, and there are rockeries, overlapping water systems, and combinations of plants. Different plant heights, varieties, and different visual levels of ornamental effect are the highest test points of ornamental value. However, there is no rest seat, and the canopy of trees is small, which can not create a complete shelter space, so it is a test point with slightly lower comfort (Figure 6).

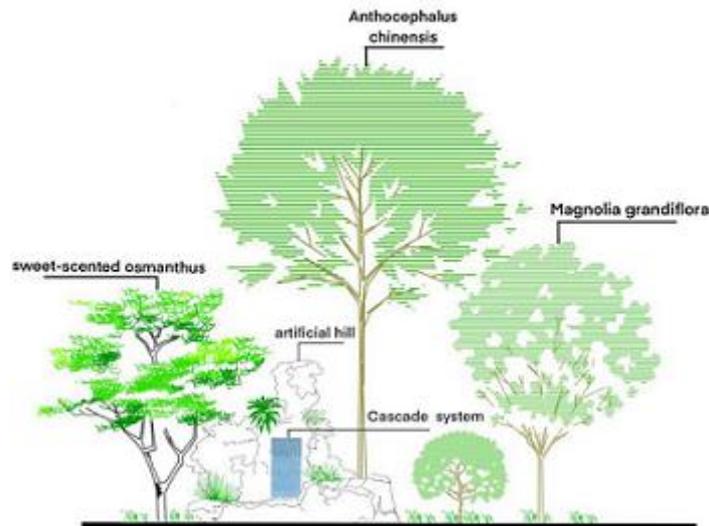


Figure 6. Elevated view of the plant landscape of Linglong waterside pavilion North.

Huan Hong Kua Lv Qiao has the best shielding effect at 12 noon. There is no sunshine on the bridge and it is a good sheltered space. Located next to the pool and ventilated, with certain microclimate improvement conditions. But other times, depending on the sun's azimuth, most of the time direct sunlight, is the lower comfort test point.

Sun Songlin [23] mentioned in "Study on Landscape Garden Design Strategies Based on Climatic Factor Analysis" that solar radiation is the source of ground and

atmospheric heat and is an important reason for the formation of different climates. Under sunlight, different paving materials cause The temperature is also different .The open space in front of the *Wo-piao* Lodge is sheltered by no buildings, so the sun is directly on the ground. The ground pavement is covered with heat-absorbing tiles, and although plants are planted, it is too small to enclose the whole space to form a Shelter space, so the temperature is the highest, and the number of people arriving is the least, so it is the test point with the lowest comfort level.

4. Conclusions

The Analysis of Landscape Design of *Yu Yin Shan Fang* Based on Analysis:

The water body is placed in the center of the garden and is closely connected to the main building. The water body controls the temperature rise between the building and the pond, and the water vapor evaporates and dissipates heat. The shielding effect of plants and buildings makes the space effectively shielded, reduces the radiation from the sun and lowers the surface temperature. If water bodies, plants, and buildings are in the same space, microclimate changes can be well formed, reducing regional temperature and increasing human comfort. Plant landscaping is mainly distributed around the building.

Although the area of *Yu Yin Shan Fang* is small and there are many architectural arrangements, the spatial scale is not restrictive but flexible. The building and the garden space are closely combined to form a enclosed space, which effectively resists natural disasters such as heavy rain and typhoons. The shaded area caused by the space and the cold lane space formed between the buildings can effectively avoid direct sunlight and reduce the temperature.

Among Lingnan gardens, climate issues are the most important considerations for gardening. By cognizing and using natural factors such as water, light, rainfall, and wind, the creation of Lingnan architecture is the result of previous thinking and continuous experimentation. Although in the modern life with the continuous development of technology, the design elements in these spaces have not been passed on, and there are relatively few cases of using. Hoping that by analyzing and refining of the results, the modern landscape design and the traditional Lingnan smart garden landscape will be better combined.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Author Contributions

Z.Y.G put forward the research conceptualization after making formal analysis, making research methods, coordinating the project plan after the start of implementation, research investigation, data collection through software to make data charts and verification, after the preparation of the first draft review and editing to complete the writing. N.C. gave guidance on the research methods, review and editing of this study. Provide support for the use of instruments, funds. J.Y. assists in the investigation and data collection of the whole study.

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