

Article

Visual Effects Created by Perforated Windows in Yangzhou Salt Merchant Gardens: A Case Study of the Ho Family Garden

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Abstract

Perforated windows are essential landscape elements in Chinese classical gardens that combine artistic design with multiple functions. This study examines the Ho family Garden, a representative Yangzhou salt merchant garden, to classify perforated windows by type, spatial distribution, and dimensions. This study analyzes representative examples from various spaces and types to assess their visual effects, from static perspectives, focusing on landscape interfaces at different viewing distances, and dynamic perspectives, exploring their impact along different tour routes. The research also explores the penetrable viewing effects of perforated windows in the West Garden of the Ho family Garden and the sight system they create. The survey reveals that the setting characteristics of the perforated windows are related to the mode of spatial enclosure. Variations in the interface data of perforated windows at different distances relate to window size, while passive viewing effects depend on the location and number of perforated windows. The changes from the dynamic perspective primarily result from the landscape elements along different routes. In the West Garden, the penetrable view between the perforated windows and the doors increases the depth of landscape elements and spatial layers. The quantitative analysis reveals Yangzhou gardens' unique spatial aesthetics while offering insights for contemporary landscape design.



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Keywords: Ho family garden; perforated windows; scale quantization; visual analysis

1. Introduction

Since the Chenghua (1465–1487) and Hongzhi (1488–1505) periods of the Ming Dynasty, significant reforms in the salt administration system of Huaibei and Huainan led to the concentration of salt merchants in Yangzhou. This resulted in the emergence of the He-Xia salt merchants community, which profoundly influenced the region's politics, economy, culture, architecture, and garden landscapes. The wealth and refined tastes of these merchants elevated Yangzhou's private gardens during the Ming and Qing dynasties to the pinnacle of Chinese garden design, characterized by unique layouts, rockery and water arrangement techniques, and distinctive architectural and horticultural features. In 2014, “Yangzhou Garden Construction skills” was approved by the State Council to be included in the fourth batch of national intangible cultural heritage representative projects list. For instance, the gardening techniques include hiding water bodies within plantings and rocks, along with the strategic use of walls, gates, corridors, and windows to create a sense of virtual and real alternation (虚实相间). A notable example is the use of perforated

windows, where the openings within the walls are virtual within the real (实中有虚), and the framed scenery viewed through these windows is real within the virtual (虚中有实) [1].

Perforated windows, also known as “latticed windows”, are characterized by intricate carvings or patterns in their openings [2]. In *The Craft of Garden* (Yuan Ye 园冶), this design is called a “perforated bright wall”, implying “emptiness and brightness” [3]. These windows, which evolved from traditional window frames, can be categorized into three types, based on their degree of transparency and shape: hole windows, latticed windows, and scenic windows. Hole windows consist solely of a frame without a grid or core. Latticed windows incorporate a full grid within the frame, while scenic windows feature elaborate carvings around their openings, making them common in garden architecture [4]. Perforated windows exhibit diverse shapes and designs, serving multiple functions such as lighting, ventilation, decoration and spatial division.

Compared with Chinese classical gardens, the research on window art in Western countries has mainly focused on the decorative art of stained glass windows in churches. Laurence Sickman and Alexander Soper have documented European studies on traditional Chinese architectural fenestration from as early as the 15th century [5]. However, due to disparities in regional characteristics, philosophical traditions, and cultural practices, these early Western interpretations remained superficial, and only simple sketches of window decorations were presented. The plant-decorative art described by art historian Riegel in his book shares similarities with the plant patterns of latticed windows in Chinese classical gardens [6]. Hikobu Ryota explored the cultural history, material characteristics, deformation, and symbolism of windows, providing a new comparative perspective between Europe and Japan for the study of windows [7].

Most studies on perforated windows in the traditional Chinese gardens have focused on their historical evolution, cultural aesthetics, artistic value, landscaping techniques, and design applications [8–15]. Recent studies have analyzed the relationships between door and window openings and space in Jiangnan gardens from both dynamic and static perspectives [16]. Other studies have examined the types and characteristics of the space on both sides of the Lingering Garden’s perforated windows, in order to clarify the scenic mechanism of the space on both sides [17]. Further studies applied transparency theory to analyze the landscape space pattern of the door and window openings in the Lingering Garden [18], while others have investigated the influence of natural light on the landscape composition of garden windows [19]. One notable study focused on four renowned Lingnan gardens to examine the typologies, decorative characteristics, and aesthetic qualities of their doors and windows [20].

Research on perforated windows in Yangzhou gardens remains limited. Some authors have elaborated on the types and decorative features of the windows in the Ho family Garden [21], and a systematic introduction of Yangzhou garden windows includes a brief mention of perforated windows in the Ho family Garden [22,23]. Wang Linlin categorized the window and door decorations of the Ho family Garden as an example [8], and Zhang Jing explained the influence of the design concept of the Craft of Garden on the window lattice patterns in Yangzhou gardens [24]. However, detailed quantitative studies linking perforated window designs to their effects on landscape composition in Yangzhou gardens are notably scarce.

The Ho family Garden, a prime example of Yangzhou private gardens, is known as “the first garden of the late Qing dynasty”. Built by He Zhidao (何芷舫) [25] during the mid-Qing dynasty, it spans over 14,000 m², with more than 7000 m² of built space. The whole garden is divided into four areas: the East Garden, West Garden, Residence Courtyard, and Small-Rock Mountain Adobe. The Ho family Garden has a rich variety of windows, and

the combination of corridor walls, perforated windows, doors and other elements creates a “scenery-shifting-with-every-step” (移步换景) effect for visitors.

In this study, we carried out the following:

- (1) Cataloged and categorized all perforated windows in the garden, measuring their key dimensions;
- (2) Analyzed representative examples across different spaces and types, assessing their landscape interfaces at varying viewing distances and angles;
- (3) Examined dynamic visual effects along selected tour routes, focusing on sequences of perforated windows;
- (4) Evaluated the penetrable viewing effects and spatial sightline systems in the West Garden as a case study.

Through this quantitative approach, this research highlights the distinctive design features and spatial aesthetics of perforated windows in Yangzhou salt merchant gardens. This provides an intuitive understanding of Yangzhou private garden landscaping techniques. The characteristics of Yangzhou classical gardens are historically important, including the influence of the architectural style of the salt merchants’ native regions, and the influence of the royal garden and the literati garden style. These findings offer valuable insights for incorporating Chinese design elements into modern landscape architecture.

2. Methods

2.1. Investigation on the Current Situation of the Perforated Windows in Ho Family Garden

This study first conducted an on-site survey to document the quantity and distribution of existing perforated windows in the Ho family Garden. Based on the two major types (hole windows and lattice windows), further classification was performed according to the materials and locations. Following the standard tour route, which begins at the east entrance and exits from the south, all perforated windows were grouped based on their location within the same area or along connected walls. Each perforated window in the Ho family Garden was categorized according to these groupings. The specific locations, materials, and types of 18 representative perforated windows were recorded, their sizes and heights were measured, and photos were taken. The size of a perforated window is the length and width of the outer frame, and the height is the distance from the lower edge of the perforated window to the standing surface of the person. Photographic documentation was conducted at a height of 1.7 m level, aligning with the average human sightline for consistent visual representation.

2.2. Viewing Analysis

The static and dynamic viewing data of the perforated windows in Ho family Garden were all extracted from the photos taken perpendicular to each window. All images were captured using identical equipment with standardized shooting parameters to ensure consistency. Furthermore, photography was conducted within a single day to maintain uniform seasonal and lighting conditions. Three intuitive data parameters were selected: the number of landscape elements, color diversity, and plant species. To align with the actual tourist viewing experience, the numbers of landscape elements and plant species were manually identified and recorded based on the field of view within each photograph. The color diversity was extracted from the photos using Color Impact analysis software (v3.1), and the HSB value is extracted and compared with the data of individual elements for verification. The difference in each value of the HSB color parameters did not exceed 5%, thereby determining the number of main colors. The changes in the data were recorded and compared using an Excel table.

3. Results

3.1. Types, Numbers and Spatial Distribution of Perforated Windows in Ho Family Garden

3.1.1. Types and Number of Perforated Windows

The perforated windows of Ho family Garden are categorized into two types: latticed windows and hole windows. Latticed windows are further divided by material into brick latticed windows and tile latticed windows, while hole windows are classified as brick hole windows or whitewashed wall hole windows. Based on their location, the windows fall into three groups: interior wall windows, border wall windows, and corridor wall windows. Interior wall windows and corridor wall windows are typically situated within the garden, allowing views from both sides. In contrast, border wall windows are visible only from the garden's interior and are usually taller (>1.5 m), serving to block the line of sight. The survey revealed that the border wall windows are all brick windows, while the majority of the interior wall windows and corridor wall windows are tile windows. Brick windows located in the interior or corridor of the building walls are larger in size, with more delicate cores, mostly with a combination of curved and straight patterns. These include shapes like begonias and multi-petal forms. Tile windows, often more dynamic in design, are characterized by curved patterns. Among the hole windows, only one whitewashed wall hole window exists, located in the Small-Rock Mountain Adobe area, with a crescent moon shape. The frame view of hole windows is better, and the height is more suitable for visitors to stay and interact. In total, the Ho family Garden features 14 hole windows. Latticed windows, predominantly made from local bricks and tiles, include 98 brick latticed windows and 48 tile latticed windows, showcasing various intricate patterns. The distribution and specific numbers of these windows are illustrated in Figure 1.

In total, 18 representative perforated windows are located in key landscape areas, evenly distributed along the main tour route, within the four distinct sections of the garden. Detailed information about these representative windows is summarized in Table 1.

Table 1. Representative perforated windows in Ho family Garden.

Serial Number	Location	Material	Type	Height (m)	Size (m × m)	Photograph
A2	corridor in the left of the east entrance	gray tile	corridor wall latticed window	1.41	1 × 1.27	
B4	east entrance opposite wall	gray tile	interior wall latticed window	1.42	1.24 × 1.24	
C15	south of Peony Hall	gray tile	internal wall latticed window	1.03	1.06 × 1.35	
D1	corridor in the right of Boat Hall	water-milled small gray brick	corridor wall latticed window	1.18	1.78 × 1.78	

Table 1. Cont.

Serial Number	Location	Material	Type	Height (m)	Size (m × m)	Photograph
D6	corridor between East and West Garden	large gray brick	corridor wall hole window	1.15	1.58 × 1.62	
E3	south double-lane corridor in West Garden	large gray brick	corridor wall hole window	1.17	1.21 × 1.24	
D5	northeast corner of West Garden (beside the stairs)	Water-milled small gray brick	corridor wall latticed window	1.35	2.18 × 2.20	
E5	second floor of south double-lane corridor	large gray brick	corridor wall hole window	0.95	1.65 × 1.03	
E9	second floor of south double-lane corridor	large gray brick	corridor wall hole window	0.94	1.21 × 1.24	
F4	right wall of Osmanthus Hall	small gray brick	border wall latticed window	about 4	not quite clear	
H2	second floor of west double-lane corridor in Residence Courtyard	small gray brick	corridor wall latticed window	1.04	2.15 × 1.76	
I2	high wall in the west of Nanmu Hall	small gray brick	corridor wall latticed window	About 3	not quite clear	
K5	west fence of Ho family Garden	small gray brick	border wall latticed window	1.56	1.6 × 1.41	

Table 1. Cont.

Serial Number	Location	Material	Type	Height (m)	Size (m × m)	Photograph
J2	north side of the entrance of Small-Rock Mountain Adobe	gray tile	corridor wall latticed window	0.98	1.07 × 1.10	
J1	entrance to Small-Rock Mountain Adobe	small brick	corridor wall latticed window	0.98	0.52 × 1.19	
J18	corridor in Small-Rock Mountain Adobe	whitewashed wall	corridor wall hole window	1.33	0.57 × 0.57	
K3	opposite the entrance to Small-Rock Mountain Adobe	gray tile	corridor wall latticed window	1.15	0.92 × 1.02	
J38	south fence of Small-Rock Mountain Adobe	small gray brick	border wall latticed window	1.46	not quite clear	

3.1.2. Distribution of Perforated Windows in Various Spaces of Ho Family Garden

According to the visually accessible enclosure of the visitors' location, the Ho family Garden is further divided into five types of spaces: rockery and buildings surrounding water space, walled buildings surrounding rectangular space, walled buildings surrounding square space, four-sided buildings enclosing inner court space, and two-sided buildings with banded connectivity space (Figure 2). Information on the types of spaces, their locations, areas, and the numbers of perforated windows they contain is shown in Table 2. In general, larger spaces tend to contain more perforated windows, as these windows are predominantly installed in enclosure and corridor walls. Spaces bounded by enclosure walls, such as S1-02, S2-05, and S3-01, have significantly higher numbers of perforated windows. In contrast, spaces dominated by buildings (S4, S5) have fewer or no perforated windows. When present, the windows in these areas are higher brick windows, ensuring privacy while still maintaining some visual connectivity. The space of S1 category, which includes the main landscape area of the Ho family Garden, features the richest combination of landscape elements and the most diverse perforated windows. These windows play a critical role in guiding sightlines and creating visual connections, enhancing the overall scenic experience. Additionally, they serve as integral decorative and functional elements, harmoniously blending with the garden's design to highlight the art of view borrowing (借景).



Figure 1. Distribution and quantity of perforated windows in Ho family Garden.

Table 2. Spaces and perforated windows in Ho family Garden.

Type of Space	Serial Number	Location	Area (m ²)	Number of Perforated Windows	Type of Perforated Windows
rockery and buildings surrounding water space	S1-01	Shuixin Pavilion in West Garden	799	16	brick hole windows + brick latticed window
	S1-02	in front of Osmanthus Hall	313	18	brick latticed window
	S1-03	north of Shangyue Building	241	5	brick latticed window
	S1-04	south of Shangyue Building	203	8	brick latticed window
	S1-05	walled rockery in East Garden	44	0	
	S1-06	artificial mountain in Small-Rock Mountain Adobe	542	10	tile latticed window
	S1-07	gazebo in Small-Rock Mountain Adobe	174	7	whitewashed wall hole window + tile latticed window
	S1-08	foyer in Small-Rock Mountain Adobe	38	6	brick latticed window + tile latticed window

Table 2. Cont.

Type of Space	Serial Number	Location	Area (m ²)	Number of Perforated Windows	Type of Perforated Windows
walled buildings surround rectangular space	S2-01	north of Boat Hall	198	0	
	S2-02	between Boat Hall and Peony Hall	266	2	brick hole window
	S2-03	south of Peony Hall	119	8	brick latticed window + tile latticed window
	S2-04	south of east entrance corridor	792	9	tile latticed window
	S2-05	south of Nanmu Hall	473	24	brick latticed window
walled buildings surround square space	S3-01	east entrance	680	19	tile latticed window
	S3-02	east of Peony Hall	538	18	tile latticed window
	S3-03	north of Qima Building	309	14	brick latticed window + tile latticed window
	S3-04	south of Qima Building	611	17	brick latticed window + tile latticed window
	S3-05	southwest corner of Small-Rock Mountain Adobe	24	3	brick latticed window + tile latticed window
	S3-06	south of early Nanmu Hall in Small-Rock Mountain Adobe	126	6	brick latticed window
	S3-07	south of Ho Family Ancestral Hall -1	106	0	
	S3-08	south of Ho Family Ancestral Hall -2	96	0	
	S4-01	west of Boat Hall	89	0	
	S4-02	Yuxiu Building courtyard	355	0	
four-sided buildings enclosing inner court space	S4-03	courtyard between Yuxiu Building and Nanmu Hall	159	7	brick latticed window
two-sided buildings with banded connectivity space	S5-01	corridor between the East and West Garden	83	4	brick hole windows + brick latticed window
	S5-02	west corridor of Yuxiu Building	147	6	brick latticed window
	S5-03	east corridor of Yuxiu Building	134	3	brick latticed window
	S5-04	the middle corridor of the Qima Building	15	0	
	S5-05	interior corridor in Small-Rock Mountain Adobe-1	24	5	brick latticed window
	S5-06	interior corridor in Small-Rock Mountain Adobe-2	25	0	

3.2. Viewing Analysis of Different Types of Perforated Windows Based on Scale Quantification

The viewing experience of perforated windows in the Ho family Garden was analyzed from two perspectives: static and dynamic. The static perspective involved pausing in front of a window to view the scenery, while the dynamic perspective involved observing multiple windows continuously while moving through the garden. These windows

serve both as media for framing external scenery and as decorative objects to be admired. The static analysis further distinguished between active viewing, where visitors look out through the windows, and passive viewing, where the windows themselves are observed as part of the landscape.

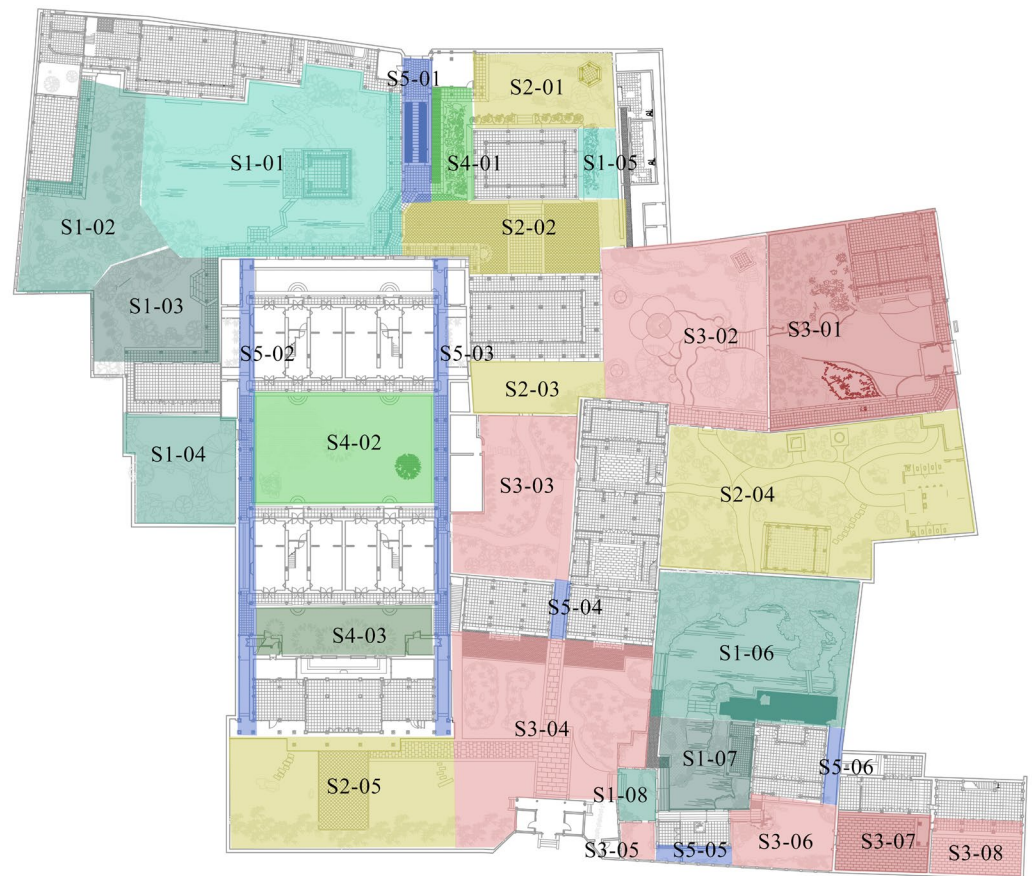


Figure 2. Space types and distribution of Ho family Garden (S1: Rockery and buildings surrounding water space; S2: Walled buildings surround rectangular space; S3: Walled buildings surround square space; S4: Four-sided buildings enclosing inner court space; S5: Two-sided buildings with banded connectivity space).

3.2.1. Analysis of Perforated Window Views from a Static Perspective

Active Viewing

As an important gardening element in Ho family Garden, windows serve not only as a decorative feature but also as a spatial tool to frame and limit the perspective of the landscape. The picture seen through the empty part of the window is the landscape interface. In the active viewing process, the landscape interface varies with the distance between the standing position and the window. Taking different types of perforated windows in Ho family Garden as an example, the active viewing effect of perforated windows was analyzed according to the landscape interface at different viewing distances in front of the same perforated windows. According to the size of the space in front of most of the perforated windows, close (1 m), medium (3 m), and far (5 m) distances were set, and the photographs taken were quantitatively compared in terms of the numbers of landscape elements, color diversity, and plant species.

Landscape elements in Ho family Garden mainly include natural elements such as sky, water, and plants, and structural elements such as buildings, corridors, doors and windows, rockeries, decorations, and paving. Plants contribute to the garden's aesthetic

and ecological value; their seasonal dynamics create temporal diversity, while the number of plant species is an important factor affecting the visual complexity (Figure 3).

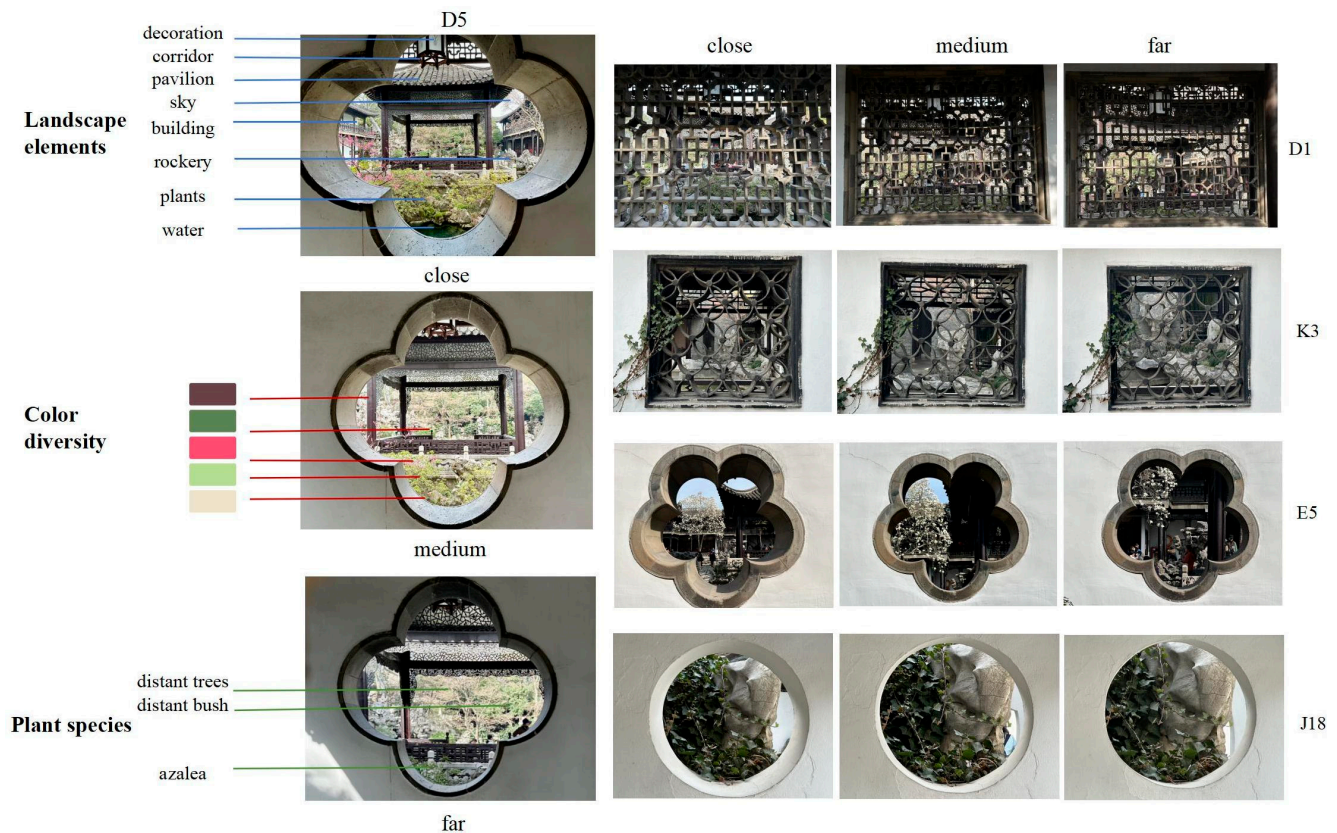


Figure 3. Visual changes at different viewing distances.

Overall, the closer the viewing distance, the more landscape elements there are within the landscape interface, the more plant species there are, and richer are the corresponding colors. The change between the close distance and medium distance is more significant, aligning with visitors' tendency to approach windows for detailed observation. Larger perforated windows, such as D5, exhibit greater variability in the landscape interface with changes in viewing distance. In contrast, smaller windows, like the J18 hole window, contain fewer landscape elements, resulting in minimal changes in viewing effect across different distances. Compared with close viewing, the landscape seen at medium and far distances is more localized, encouraging imaginative interpretation, and the space in front of the viewed perforated window is larger, with more spatial layers (Figure 4).

Passive Viewing

Functionally, the perforated window serves not only as a medium for visitors to actively view the scenery behind it, but also as a passive viewing element within the larger garden space during the tour. Four frequently visited viewpoints were selected for this analysis: the east gate entrance area, the front of Shuixin Pavilion in the West Garden, the southside of Yuxiu Building, and the front of Small-Rock Mountain Adobe. Photos were taken in the main field of view from a visitor's standing position. By counting the number of perforated windows, the proportion of the visual field they occupy and the number of landscape elements in the pictures, the passive viewing effect of different types of perforated windows in different viewpoints was analyzed (Figure 5).

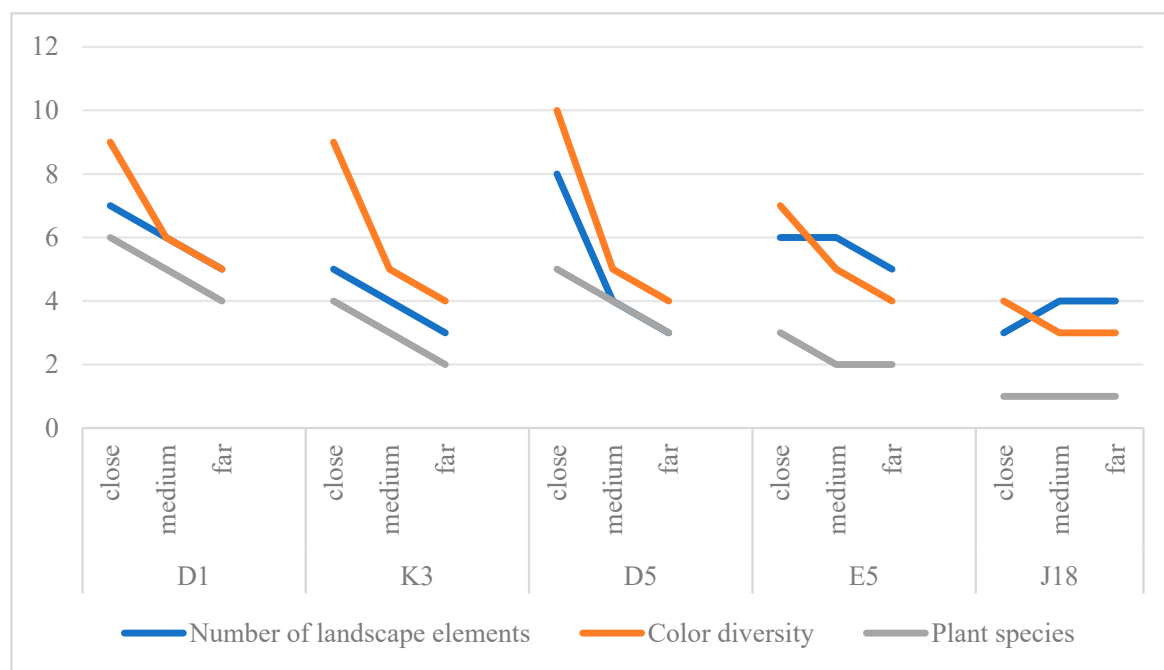


Figure 4. Data changes at different viewing distances.

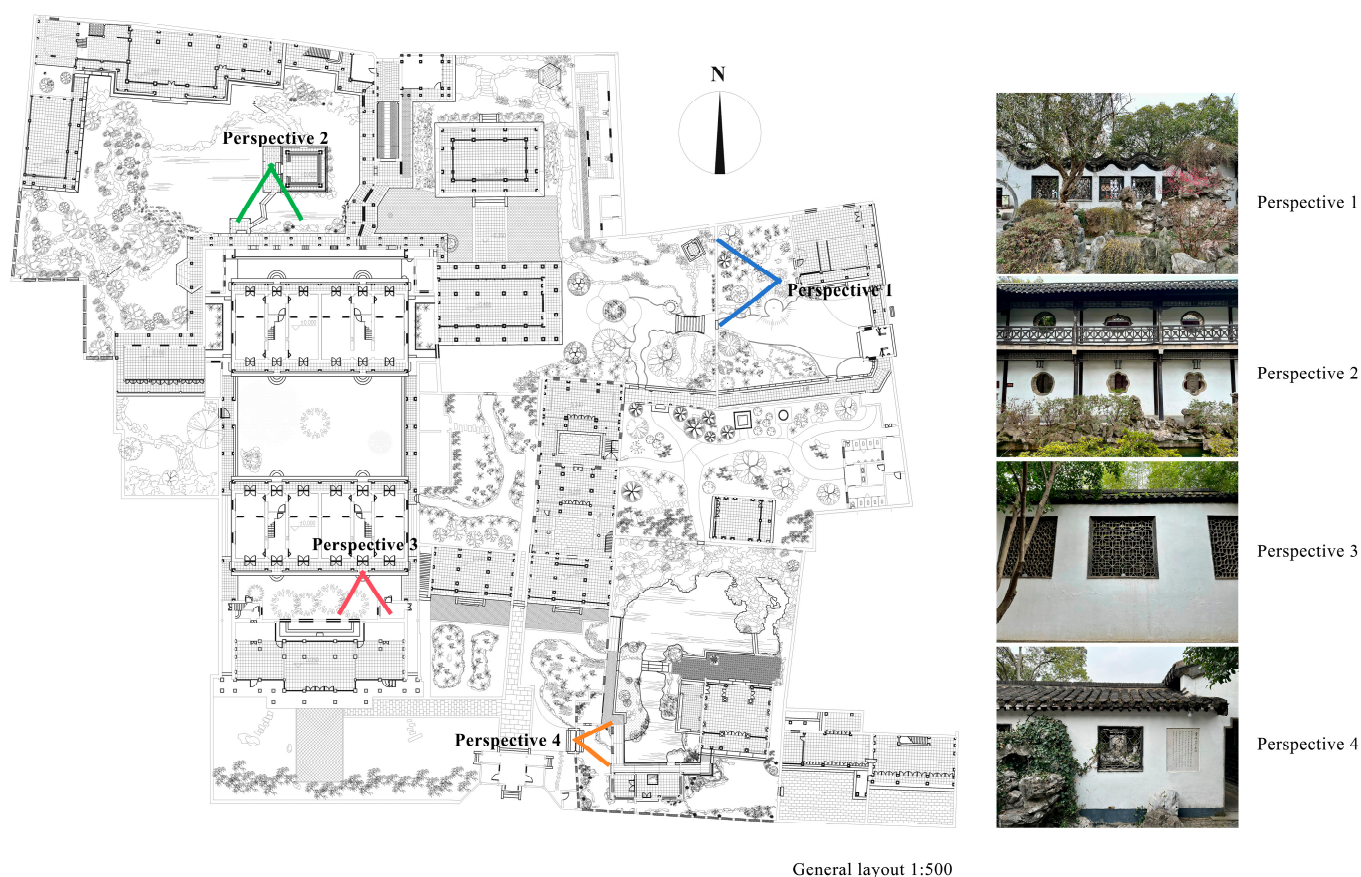


Figure 5. Different viewing perspectives in Ho family Garden.

The results of Figure 6 indicate that the number of perforated windows and the number of landscape elements do not correlate. The number of elements in different perspective depends on the location of the perforated windows, surrounding entourage, and plant species. However, a large proportion of perforated windows are in the field of view, often

due to the larger size of the perforated windows and the presence of less shading in front of them. Such perforated windows tend to play a role in dividing the space (perspective 3). When multiple perforated windows appear in the same field of view, they reduce the monotony of the overall spatial background while enhancing the ornamental quality of the space and guiding the route (perspective 1, 2). In contrast, a single perforated window in a view creates a sense of mystery and strengthens the spatial layers beyond the window, while also highlighting the core of the window's ornamental features. Furthermore, the integrated design of perforated windows with the drip waterfall eaves, rocks, and water features creates a landscape focal point (perspective 4).

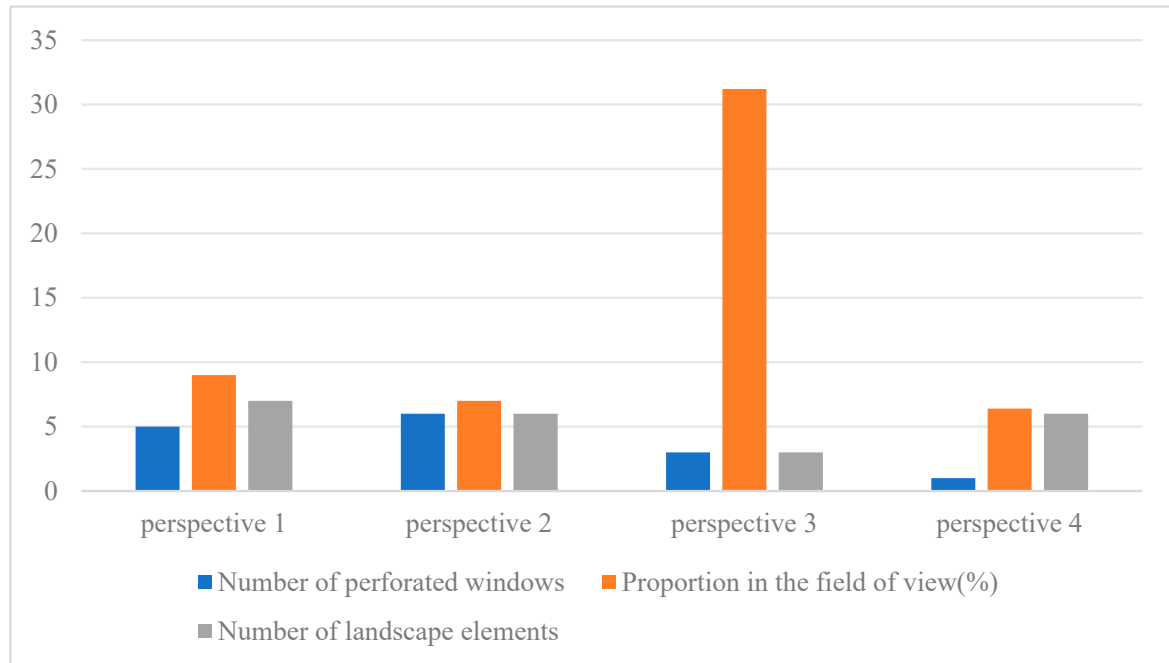


Figure 6. Data of different viewing perspectives.

3.2.2. Analysis of the Perforated Window View from a Dynamic Perspective

In contrast to the static view from a single perforated window, continuous viewing through multiple perforated windows as people move around and link multiple images together creates a unique dynamic perspective. The west corridor at the East Gate entrance of Ho family Garden and the 1500 m double-lane corridor, which enjoys the reputation of “the first corridor in the world”, are both equipped with consecutive perforated windows. To explore the dynamic viewing effect, three classic tour routes were selected within these areas, to analyze how the viewing experience changes as visitors move along the path.

The arrangement of successive perforated windows creates a rhythmic flow, guiding visitors along the predetermined route while enriching their visual experience. The three routes are as follows:

Route 1: The west corridor at the East Gate entrance, viewed from the left while walking from east to west, passing a sequence of nine tile windows.

Route 2: The second floor of the double-lane corridor in the West Garden, viewed from the left while walking from east to west, passing a sequence of six hole windows.

Route 3: The first floor of the porch at Yuxiu Building, viewed from the right while walking from west to east, passing six hole windows in the same sequence (Figure 7).

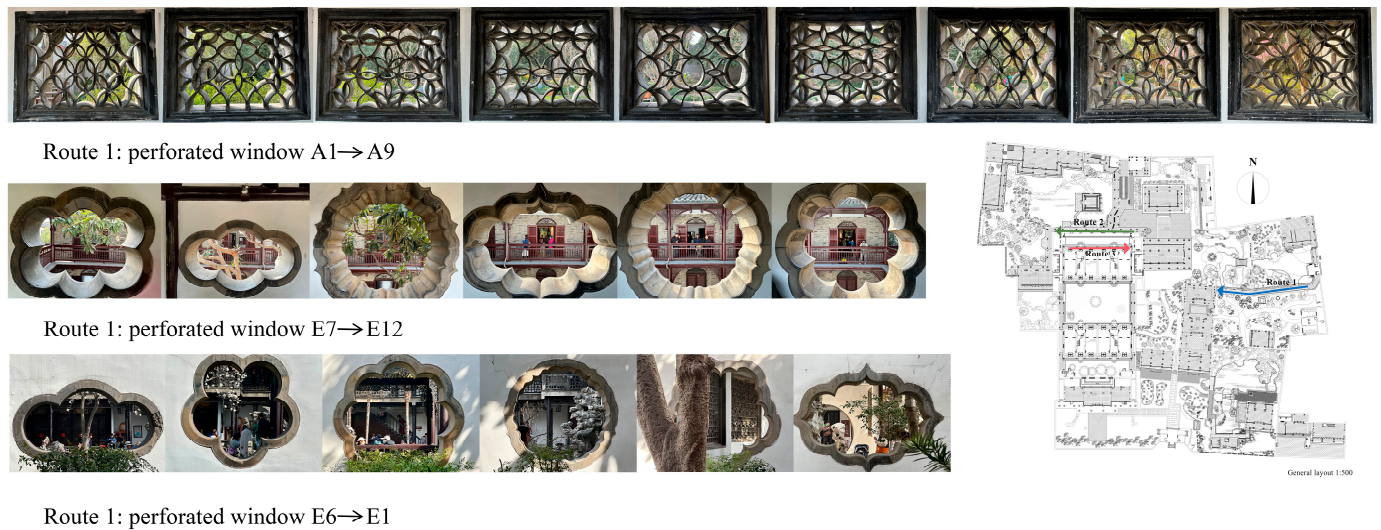


Figure 7. The perforated windows on three tour routes.

As shown in the data results in Figure 8, the trends of the numbers of landscape elements, color diversity and plant species in the perforated windows are not exactly the same along each route. It is worth noting that the perforated windows with a sudden decrease in each value tend to be at the intersection of two spaces, such as A6 in route 1 and E2 in route 3. On Route 1, the landscape framed by the latticed windows mainly consists of simple buildings and plants; so, color diversity is primarily determined by the plants, and changes follow a similar pattern. In contrast, for routes with fewer landscape elements, the changes in the landscape interface are more pronounced (as seen in route 2). For routes with more diverse landscape elements, the data changes more gradually (as seen in route 3).

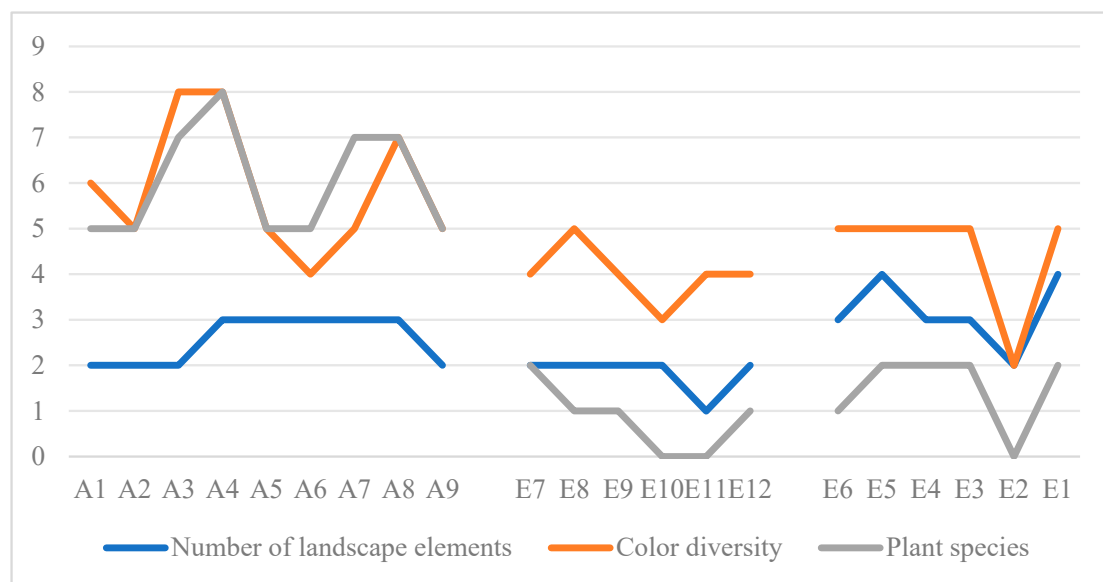


Figure 8. Data changes on three tour routes.

3.3. Analysis of the Spatial Viewing System: Taking West Garden of Ho Family Garden as an Example

The layout of Ho family Garden is centered on the garden buildings, forming a spatial relationship with tortuous boundaries and interpenetration. Perforated windows are usually located at the junction of two spaces, creating a sightline connection between vari-

ous areas, thus enabling people to appreciate the landscape of different scenes. The West Garden of Ho family Garden has a more open space, with a pool in the center, a Shuixin pavilion in the pool, a stone bridge to the east of the pool, and a rockery to the west of the pool. Surrounded by buildings such as the Butterfly Hall and Osmanthus Hall, there are also multiple corridors connecting multiple spaces.

3.3.1. Penetrable Viewing

In addition to the perforated windows, the windows and doors on the building or on the wall can increase the layer of space and enhance the depth of field. The existence of two perforated windows or perforated windows and doors arranged in the same viewing sight line around the West Garden greatly increases the numbers of landscape elements, colors, and spatial layers. Figure 9a shows the arrangement of a latticed window and the hole window. In addition to the pavilion and plant elements outside the hole window, the corridor wall, door, and decorative lanterns in front of the hole window are added, and the spatial layer also increases with the corridor. In Figure 9b, the arrangement of the hole window and the doors before and after the building increases the multi-layer space in the north courtyard of Yuxiu Building, the interior of the building, and the courtyard of the building. Figure 9c is from the inside of Yuxiu Building viewing outwards, formed by the door of the building and the arrangement of the hole window, showing the multi-layer landscape of the courtyard in front of the building and the West Garden. This could be experienced by the owner of the garden in the living area, offering a glimpse of West Garden view from afar, and showing the characteristics of the combination of Chinese and western architecture in the Ho family Garden [26].



Figure 9. (a) Arrangement of perforated window D1 and D6; (b) arrangement of perforated window E3 and shutter door of YuXiu Building; (c) arrangement of perforated door of YuXiu Building and perforated window E3.

3.3.2. Sight System Constructed by Perforated Windows

The West Garden contains the largest variety and number of perforated windows in Ho family Garden. As shown in Figure 10, the space penetrated by the arrows represents the space accessible through the sight lines of the perforated windows, with the single line arrow indicating one-sided viewing and the two-way indicating two-sided visibility. The orange arrow is the sightline through the brick perforated window and the hole window on the east side of the West Garden, where the perforated window is large enough to see the Boat Hall and the courtyard in the East Garden. When visitors enter the West Garden from the East Garden, the beauty of the West Garden attracts them with the imagery of virtual and real. Indicated by the red arrow, in the West Garden, the two rows of windows above and below the double-lane corridor are arranged in correspondence with the doors of Yuxiu Building. These sightlines go through the interior to the central courtyard without a clear end, endlessly sparking visitors' imaginations. At the same time, from in-

side Yuxiu Building or its balcony, the view from the opposite direction frames the West Garden like a painting, with the hole windows serving as the frame for the scene. The perforated windows where the blue arrows are located are brick latticed windows that are very high and which can only be viewed upwards from the West Garden, providing a clear sense of boundary. Through the sight system of the perforated windows, the position of the West Garden in the whole Ho family Garden can be better understood, and the space itself is extended.

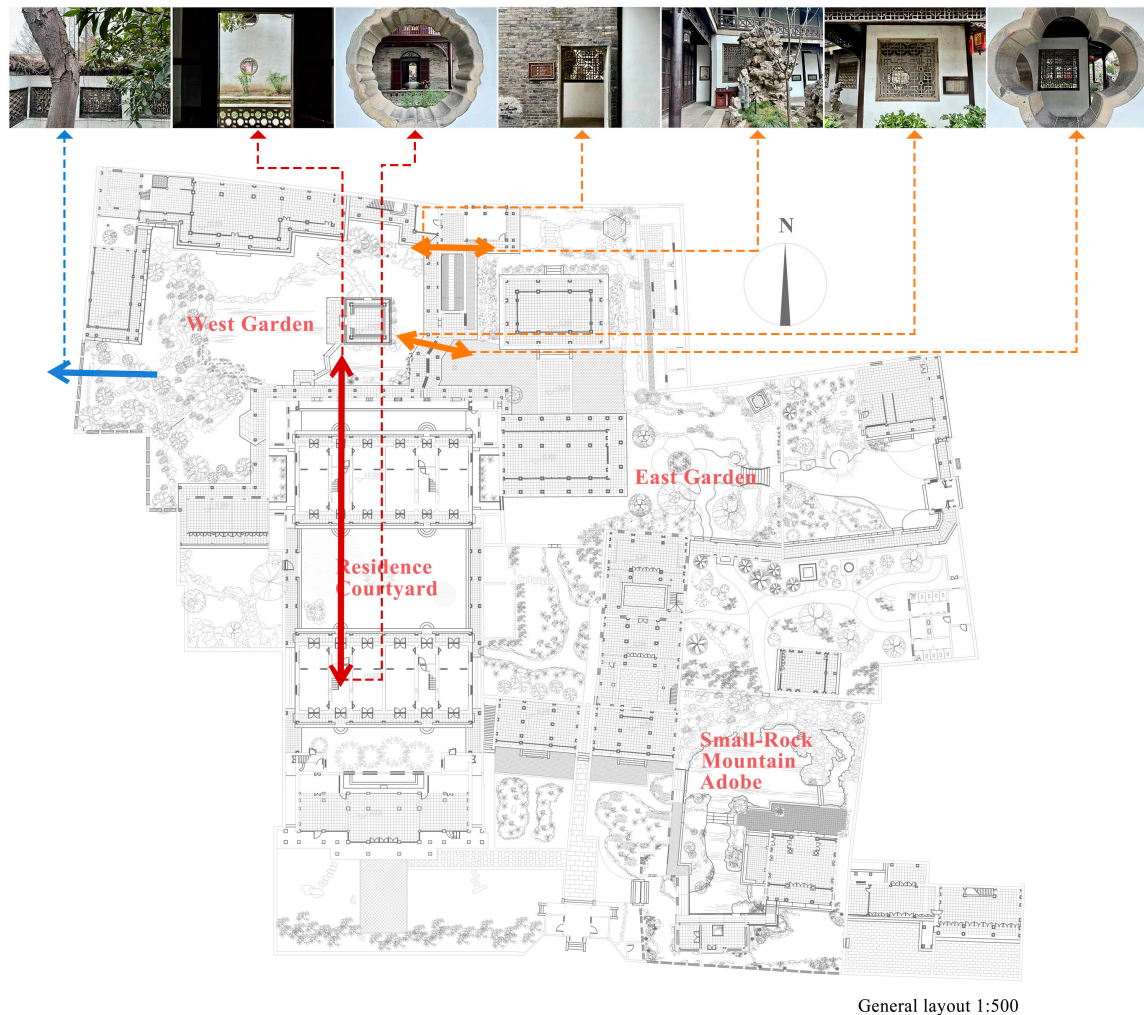


Figure 10. Sight system constructed by perforated windows in the West Garden.

4. Discussion

Yangzhou gardens, heavily influenced by the Craft of Garden, feature distinct landscaping methods that reflect the region's unique aesthetic, particularly in salt merchant gardens [27–29]. Yangzhou gardens achieve their “communicable, viewable, habitable, and tourable” purpose through a series of spatial design techniques. The West Garden of Ho family Garden is separated by a corridor, and the various corridors combined with the perforated windows serve to “hide flaws and highlight virtues” [30]. As visitors move from the East Garden into the West Garden, they first glimpse parts of the scenery through perforated windows, with the line of sight narrowing before opening up to reveal the main attractions of the pool, pavilion, and distant rockery, creating a visual impression of “concealment followed by revelation” (欲扬先抑) [1].

Compared with other types of private gardens, Yangzhou gardens exhibit distinctive characteristics in gardening skills and the application of perforated windows. Although

both Suzhou gardens and Yangzhou gardens belong to the Jiangnan classical garden tradition and share certain commonalities, they diverge significantly in stylistic expression. From a macro perspective, Suzhou gardens predominantly represent the literati garden tradition, embodying an aesthetic of secluded tranquility that reflects Confucian ideals of reclusion. In contrast, Yangzhou gardens were commissioned by merchant elites as manifestations of cultural capital and socioeconomic status. At the micro level of individual structures, Suzhou gardens demonstrate architectural minimalism characterized by a restrained chromatic palette (predominantly white and dark gray) and planar circulation routes. Yangzhou gardens, conversely, feature bigger architecture and complex travel routes. Regarding perforated window designs, Suzhou gardens employ not only geometric motifs but also feature patterns of animals, plants, and literati's symbols (e.g., music, chess, calligraphy and painting). Yangzhou gardens, however, utilize perforated windows with comparatively simplified patterns at larger scales and with a higher density of deployment [31].

The morphology and decorative patterns of doors and windows in Lingnan gardens are profoundly shaped by the region's distinctive cultural identity. Characterized by vibrant polychromy, their ornamentation reflects vernacular symbolism, often embodying popular aspirations for auspiciousness and prosperity. Furthermore, under the influence of maritime commercial culture, Lingnan developed a pronounced receptivity to Western aesthetic principles, actively assimilating foreign decorative motifs. This eclecticism creates a striking contrast with the restrained elegance of Jiangnan's traditional literati gardens, highlighting divergent cultural orientations between these two regional garden traditions [20].

5. Conclusions

This study, based on the survey and classification of all perforated windows in the Ho family Garden, analyzes the changing landscape views in different spaces and window types as the viewing distance shifts. Additionally, it explores the role of perforated windows as passive viewing elements, revealing how they contribute to the creation of visual landscapes in the garden. From the dynamic perspectives of ancient garden owners and visitors today, this study tracks how the viewing effect evolves along classic tour routes. The analysis of the West Garden highlights the spatial view system formed by the perforated windows. This better reflects the characteristics of a salt merchant's garden, where the master's status was displayed through the way of "seeing the universe in miniature" (以小见大) [1].

The analysis of the visual creation of the perforated windows of Ho family Garden not only reveals more about the art of salt merchant gardens but is also conducive to the application of classical garden art in modern design. In contemporary garden landscapes, different forms of window and door openings can also be utilized to create spatial-visual effects. The choice of window locations, the use of windows to separate or expand spaces, the optimization of landscape elements (including plant configuration and color schemes), and the consideration of the tourists' point of view of multiple interfaces with transforming and imaginative effects--all these factors can be quantified in the form of more ideas for the design to achieve.

This study has certain limitations. Yangzhou's salt merchant gardens encompass a diverse typology, including residential gardens (e.g., Ho family Garden), public gardens, guild gardens, and temple gardens. Residential gardens have been relatively well preserved throughout history, and the types and quantities of perforated windows are also the most abundant. However, the present research focuses solely on He Garden as a case

study, which may not fully capture the broader design principles of salt merchant gardens as a whole.

The exploration of perforated windows' visual effects and their spatial relationships with other landscape elements provides a foundational framework for investigating broader design strategies. Future research should expand the scope by incorporating additional case studies from other salt merchant gardens, examining not only perforated windows but also related architectural features such as door openings, pavilions, and corridors. A comparative analysis across different garden typologies would further elucidate the unique aesthetic characteristics of Yangzhou's salt merchant gardens and the skills that contributed to their creation.

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