Quantitative Study on Opening and Closing of Mountain Campus Landscape

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Abstract:

Vision change is the key element of the image expression of walking space in mountain colleges and universities. Equivalent visual research is one of the most important research method. Landscape enclosure and opening can enable walkers to obtain dynamic spatial experience and combine the mountain shape trend. Through the view analysis of Depthmap node and the line of sight hierarchy analysis of line of sight depth, it is concluded that the higher the change degree of view, especially the close range view, the more obvious the performance of mountain natural image. At the nodes where the horizon changes dramatically, especially at the nodes where the horizon suddenly enlarges, combining the campus cultural elements with the landform can strengthen the pedestrian's perception of the campus cultural image.

Keywords: *Landscape horizon, Mountain Campus, Landscape opening and closing, Landscape design*

I. INTRODUCTION

Line of sight analysis is a quantitative research method in special landscape opening and closing, which is an important means of Chinese traditional gardening. Peng Yigang proposed that the spatial comparison design methods are diverse through the study of Chinese classical gardening [1]. Liu binyi proposed that the change range and feeling time length of two adjacent landscape spaces can affect the instantaneous perception of the viewer's space, concluded that the dynamic change process of landscape sequence during walkers' tour can trigger people's perception[2]. Sun Peng uses traditional theory and spatial syntax to analyze the space of Chengde Summer Resort, and obtains the application of spatial syntax in Chinese traditional natural Gardens[3] [4]. B. Jiang studied the accessibility of functional layout generation of urban street patterns [5] [6], and concluded that the more spatial information given by the field of view, the more it can guide the walker to stay [7] [8]. Zhang Shu made a quantitative analysis of the Zhuozhengyuan garden and discussed the change regular pattern with the tour route [9]. Du Rong studied the horizon change of multiple viewpoints and sociological network analysis, and proposed a quantifiable horizon landscape structure layout method[10].

University campus is regarded as a special kind of garden and the carrier of the inheritance of gardening art, which provide walkers a dynamic spatial experience and influent their behavior[11] [12] [13]. In mountain colleges and universities, with other factors as architecture, plants, etc., topographic relief plays the main factor for the special opening and closing. The view changes not only with the position in plan, but also with the latitude of the observer, which makes it impossible to analyze the opening and closing in a single plan. The paper analyses Huxi campus of Chongiqng University to reveal the application of special opening and closing in mountain universities campus design, and its similarities and differences with traditional gardens.

II. MATERIALS AND METHODS

2.1 Spatial analysis method of mountain landscape

Select the main landscape route in the campus, pick nodes at equal distance. Based on pedestrian's own feelings, determine the visual field characteristics and the way to judge the visual obstacles. Use the spatial syntax software. Depthmap to quantify and qualitatively analyze the visual field of each node. Discusse the changes of nodes in the path. Equivalent visual research take the high of 1.5m from ground which is the average height of Chinese university students. University campuses usually has a larger scale, a pedestrian usually cannot see the boundary of the campus, and the impact of sight distance on visual experience cannot be ignored. According to the scale of observable expression details which can distinguish the contour of the human body, take 25m and 100m as analyze radial of equivalent visual research, and topographic relief, architecture can be the boundary. The plant which permeability is less than 50% is regarded as boundary, otherwise is treated as transparent.

2.2 Materials and methodology

Employ software of depthmap for node view analysis, including relative connectivity C 'and line of sight depth. The relative connection degree is the proportion of the space range directly seen under a certain sight distance,which is the opening and closing degree of the space. After meshing the view graph, analyze its connectivity CI. Divide the connectivity value of the viewpoint by the circumferential range of the sight distance radius (regardless of the number C0 of all elements under the line of sight obstacle), adopt a 2m * 2m grid in the 25m sight distance radius graph and a 10m * 10m grid in the 100m sight distance radius graph, and the relative. Connectivity expression is:

$$C' = C_i/C_0$$

View step depth is a parameter that represents the line of sight hierarchy. Starting from the selection of elements, the elements that can be seen directly are recorded as one-step depth. From the element of one step depth, what can be seen directly is recorded as two steps depth, and so on. The higher the line of sight depth, the stronger the spatial hierarchy in the process of traveling. The line of sight depth is divided into 5

levels by simple qualitative analysis, which are expressed as weak, weak, general, strong and strong respectively.

2.3 Quantitative analysis of change between nodes

The dynamic change of node view is expressed by the change coefficient of connectivity. The connectivity change coefficient K is the ratio of the change in the field of view of the pair caused by the motion between nodes, which is obtained by dividing the relative connectivity of the front and rear nodes. The algorithm is to take the larger relative connectivity of the front and rear nodes as the smaller one. If the value of the latter node is larger, the connectivity change coefficient is positive. On the contrary, the change coefficient of connectivity is negative. The expression is,

$$K = if(C_{i+1} \geq C_i, \frac{C_{i+1}}{C_i}, -\frac{C_i}{C_{i+1}})$$

III. RESULT AND ANALYSIS

3.1 Result

One of the major landscape routes of Huxi Campus starts from the east gate, along the west square to the Bank of Yunhu lake, Fig1. The major landscape routes of Huxi Campus. The lakeside trail to Jinhu Road and the waterfront trail on the South Bank of Jinhu Lake, and climbs the mountain to the top of the mountain. 17 nodes are obtained at a distance of 70m and divided into 4 sections. Section 1 is from node 01 to node 04, mainly east gate entrance square. Section 2 is from node 04 to node 09, mainly Yunhubin waterway. Section 3 is from node 09 to node 13, mainly Jinhu waterfront waterway. Section 4 is from node 13 to node 17, mainly a Mountaineering Road, Table I Photos of each node of Huxi Campus route.
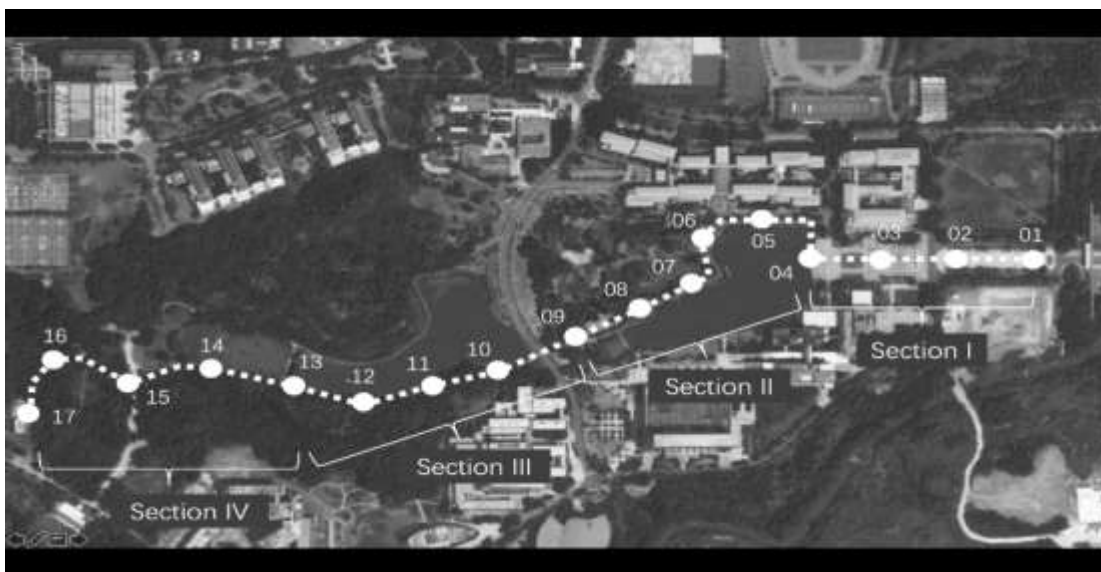
Fig1. The major landscape routes of Huxi Campus

Table I. Photos of each node of Huxi Campus route

01	02	03
04	05	06
07	08	09
10	11	12
13	14	15
16	17	

3.2 Analysis

Equivalent visual research analysis of the route is as follows, Table II Analysis of Huxi Campus route.

Table II. Analysis of Huxi Campus route

Number	Radial of isovist analysis of 25m				Radial of isovist analysis of 100m			
	C'_{25}	K_{25}	graphics	View step depth	C'_{100}	K_{100}	graphics	View step depth
1	1.00	-		weak	0.82	-		weak

2	1.00	1.00		weak	0.96	1.17		weak
3	1.00	1.00		weak	0.63	-1.54		relatively weak
4	0.94	-1.07		weak	0.49	-1.28		relatively weak
5	0.99	1.05		weak	0.63	1.28		relatively weak
6	0.59	-1.67		relatively weak	0.55	-1.14		relatively weak
7	1.00	1.69		weak	0.81	1.46		relatively weak
8	0.63	-1.59		weak	0.55	-1.48		medium
9	0.67	1.07		relatively weak	0.39	-1.41		relatively weak
10	0.73	1.08		weak	0.55	1.41		medium
11	0.79	1.08		weak	0.44	-1.24		relatively weak
12	0.69	-1.13		weak	0.38	-1.16		weak
13	0.76	1.09		weak	0.31	-1.24		relatively weak

14	0.76	1.01		weak	0.21	-1.45		relatively weak
15	0.68	-1.12		weak	0.20	-1.05		weak
16	0.84	1.23		weak	0.42	2.08		weak
17	0.71	-1.18		weak	0.05	-9.21		weak

In Section 1, the average value of C'25 is 0.99, indicating that there is almost no line of sight obstruction and the space is spacious. The average value of K25 absolute value is 1.02, the minimum value is 1.00 and the maximum value is 1.07, indicating that the field of view changes slightly. The average value of C'100 is 0.73, and the average value of k100 absolute value is 1.33, the minimum value is 1.28, and the maximum value is 1.54, indicating that the change of visual field is relatively stable. The horizon boundary mainly includes roadside vegetation, building facade and sculpture devices. Among them, node 03 is in the center of the square, imitating the old gate of Chongqing University, reducing C'100 to 0.63 and increasing the horizon level.

In Section 2, the average value of C'25 is 0.86 and fluctuates between 0.59 and 1.00. The average value of K25 absolute value is 1.41, the minimum is 1.05 and the maximum is 1.69. The change of expression field of view is relatively stable. The average value of C'100 is 0.58 and fluctuates between 0.39 and 0.81. The average value of absolute value of k100 is 1.35, the minimum value is 1.14 and the maximum value is 1.48. The average value of K25 absolute value is close to k100, indicating that the change range of field of view under the two sight distance radii is similar. The hierarchical change of horizon is weak. The view boundary mainly includes roadside vegetation and building facade.

In Section 3, the average value of C'25 is 0.74 and fluctuates between 0.69 and 0.79. The average value of K25 absolute value is 1.10, the minimum value is 1.01 and the maximum value is 1.13, indicating that the field of view changes slightly. The average value of C'100 is 0.34 and fluctuates between 0.31 and 0.55. The average value of k100 absolute value is 1.26, the minimum is 1.16 and the maximum is 1.41, indicating that the change of visual field is relatively stable. The hierarchical change of horizon is very weak. The horizon boundary is mainly mountains. The footpath is mainly in the form of water trestle.

In Section 4, the average value of C'25 is 0.75 and fluctuates between 0.68 and 0.84. The average value of K25 absolute value is 1.14, the minimum value is 1.01 and the maximum value is 1.23, indicating that the field of view changes slightly; The average value of C'100 is 0.22, which fluctuates between 0.05 and

0.42. The average value of absolute value of k100 is 3.42, the minimum value is 1.05, and the node 16~17 is 9.21. The field of view is blocked by vegetation and shrinks sharply, blocking the field of view overlooking the foot of the mountain; The horizon change among other nodes is relatively stable, with an average value of 1.53. The hierarchical change of horizon is weak. The horizon boundary is mainly mountains and vegetation, and the horizon is rich in hierarchical changes.

On the whole, in the 25m sight distance radius and 100m sight distance radius, the sight range of the route tends to be *open narrow*, and the variation range of sight range is always small. The horizon level change is very weak in the first half of the route and slightly strong in the second half. Some nodes are integrated into the campus culture in combination with the terrain, such as the sculpture of the old school gate on the East Square, the stone tablet in Section 3, etc.

Ⅳ. CONCLUSION

It is conclusion that Humble Administrator's garden and Liuyuan in Suzhou, which represent the highest level of Chinese traditional gardening art, to make a comparative analysis of spatial opening and closing, and discuss the similarities and differences. It can be seen from the figure that the change range of Huxi visual field is weak, especially lack of nodes with drastic changes.The opening and closing degrees of different sections of Huxi are obviously different, which is similar to Suzhou gardens. The higher the change degree of visual field, especially the close range, the more obvious the performance of mountain natural image. At the nodes where the horizon changes dramatically, especially at the nodes where the horizon suddenly enlarges, combining the campus cultural elements with the landform can strengthen the pedestrian's perception of the campus cultural image. When campus cultural elements make a great change in vision, they can produce strong expressiveness. Based on people's own feelings, this study uses spatial syntax software to quantify and qualitatively analyze the horizon of each node, discusses the changes of nodes in the path, and analyzes the relationship between the opening and closing of landscape space in mountain walking space.

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