Study on the Spatial Behavior Model of Macau Tourists

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Abstract: This paper gives consideration to the extremely uneven distribution of tourists in Macao during holidays and festivals, and raises questions about the urban spatial structure and the distribution of people flow. This paper tries to explain the reasons of the above phenomenon by using the quantitative analysis method of space syntax.

1. Introduction

With the relaxation of domestic outbound tourism restrictions and the increase in spending power of mainland tourists; since 2014, Macau has received more than 30 million tourists each year; according to data released by the Macau Statistics and Census Service, inbound tourists reached 35.8 million in 2018. An increase of 9.8% year-on-year, and the number of immigrants during the 7th Golden Week of November was close to 900,000, (Figures 1 and 2). This is undoubtedly an incredible figure for Macau, with an area of only 32.8 square kilometres.

Figure 1 Statistics of Macau's inbound tourists from 2013 to 2018

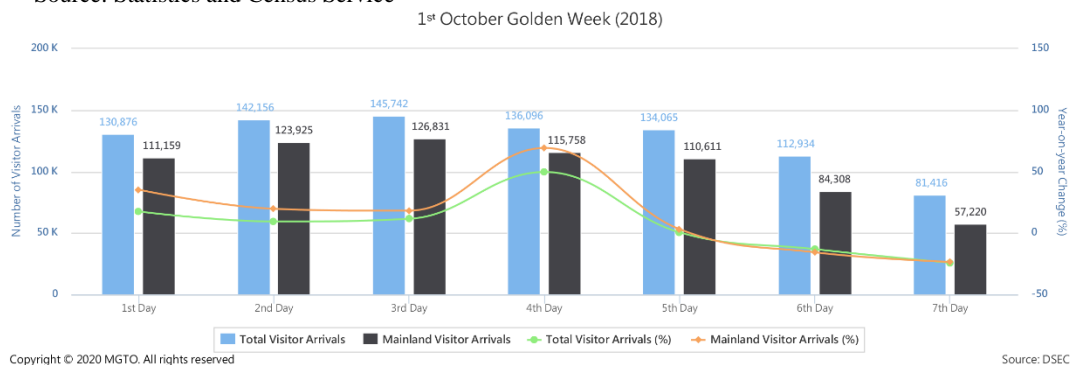Source: Statistics and Census Service

Figure 2 Statistics of Macao's inbound tourists in the 2018 Golden Week

Source: Statistics and Census Service

Obviously, the number of tourists in Macau has far exceeded the carrying capacity of Macau as a tourist and leisure city, and the proportion of resources in the number of immigrants has far exceeded the proportion of resources in the local residents. These factors have severely restricted the development of Macau's cities. (Chen Zhangxi, 2017)

The gates are crowded, and the city center is difficult to walk. Tens of millions of inbound tourists each year bring tremendous pressure to Macau cities, but what is even more serious is the

severe imbalance in the distribution of tourists at various attractions in the city.

According to the field survey of the Golden Week in November 2018, on October 2, the traffic flow from the front of the fountain on the north side of Macau's Xinma Road to the front line of Dasanba surged, and the crowded traffic once caused hidden dangers. During the same period, few tourists set foot on the line from Dongfang oblique lane on the south side of Xinma Road to Gangding Qiandi. (Figures 3, 4).

Figure 3 Dasamba Street   Figure 4 Gangding front

The uneven distribution of tourists exists in many tourist cities at home and abroad. However, this "universal phenomenon" that occurred on both sides of Macau's Xinma Road is puzzling because the north and south sides of Xinma Road actually belong to the historical district of Macau. From the perspective of the distribution of protected buildings, the protection on the north side of Xinma Road The number of buildings is comparable to the south side. In other words, compared to the north side of Xinma Road, there are also quite interesting spots on the south side. The tourism resources on both sides of the north and the south are comparable, but there is an uneven distribution of tourists. The reasons for this situation are worth exploring and researching. Not only that, but the author's field investigations in other areas of Macau found that the uneven distribution of tourists in all areas of Macao is only the most significant in the area of the above three buses-Gangdi Theatre.

Judging from the promulgated policies, several measures implemented by the SAR government in recent years are committed to increasing the number of tourists on the south side. From expanding publicity efforts to setting up conspicuous guidelines and even introducing cultural and creative industries, many efforts have been made to enhance the development of the southern region. But a series of "activation" measures have not produced good results, with little effect. So what exactly is the reason for the uneven distribution of tourists in urban space, and where is the problem?

With the above questions, the author conducted several on-site investigations on the historical districts of Macau, including the area from Sanshenba to Gangding Theatre, focusing on the situation in the area and its surroundings. After a field investigation, it was found that where there are a large number of crowds in the historical district of Macau, the surrounding businesses are highly developed, the regional development intensity is high, and the business density is concentrated. In the protected area, where there is little traffic, the business is scattered, and many areas do not even have commercial clusters. The two types of areas show distinct street vibrancy-lively and deserted. The correspondence between the prosperity of business and the volume of people may initially explain the reason for the uneven distribution of tourists-tourists always tend to lively areas with concentrated business, where there are complete facilities and diverse choices to meet the needs of different people. But then the question is, why does the phenomenon of commercial agglomeration occur only in certain areas of the city? In other words, why is the

business highly concentrated in the area of Big Three Bus and not in other areas, such as the Gangding Theater area?

2. The Significance of Research

Macau has a unique Sino-Portuguese culture. She has inherited the historical heritage of the integration of Eastern and Western cultures for more than 400 years. It has the characteristics of the integration and coexistence of Eastern and Western cultures. The different cultural backgrounds of China and Portugal have been integrated into the urban construction of Macau. Macau's urban space texture reflects its cultural advantages and characteristics. It is irreplaceable by other Asian cities, and it is also a unique capital that competes with many cities in the neighboring area. (Tong Qiaohui, 2004). In the era of leisure experience, Macau is facing a transition period from the transformation of gaming consumption to leisure experience. Facing the problems of traffic and street carrying capacity caused by the extremely uneven distribution of tourists in Macau cities, the significance of this research is mainly reflected in the following aspects:

Through the study of the evolution of urban morphology, the context of urban development can be clearly grasped, which is conducive to forecasting and controlling the future development of the city, and to a certain extent, resolves the contradictions between people and space, and enhances street vitality. The dissertation starts with the study of the evolution process of Macau's urban space, and uses quantitative research to describe Macau's urban space in detail and accurately, and finds out the problems that lead to uneven distribution of tourists in urban planning.

Quantitative research method of space syntax is used to describe the overall and accurate form of Macau's urban space. The study of the formation and evolution mechanism of Macau's city has special value. The quantitative study of urban space will recognize the identity of Macau's city. Knowledge research plays a deepening role.

The urban spatial form is the final product of the organic combination of urban physical entities with abstract political and economic factors and urban planning policies. It often shows irregular and free spatial form characteristics. Traditional description technology lacks sufficient accuracy when describing the complex spatial form of urban street networks. The definition of morphological features is often ambiguous (Yuan Sinan, 2011), and spatial syntax effectively solves the quantitative description of urban space. The above-mentioned shortcomings provide a strong support for the theoretical study of the urban spatial form of Macao.

Macao is undergoing a period of economic, social and spatial transformation. The small urban space and increasing population size have become the main contradictions that cannot be ignored. The contradiction between the traditional urban planning and the actual needs of residents and tourists is increasingly prominent, which is quite different from the ideal state of urban planning. The thesis studies the relationship between the street network of Macao, the behavioral pattern of tourists and the vitality of the street through the analysis method of the spatial syntactic "line of sight integration". According to the actual situation in Macao, new perspectives and research ideas are put forward on the interconnection between the spatial structure and tourist behavior patterns. Analyze the spatial behavior of tourists from the perspective of tourist behavior, and explore the dynamic construction of streets from the behavioral habits of people. Through the above research methods, it can make up for the deficiencies of residents and tourists in traditional urban planning, and can provide important theoretical basis and technical support for urban planning and design practice.

3. Scenic Road Form and Tourist Path Selection

The shape of the road around the scenic spot witnessed the growth of Macau. It used to be the most prosperous trade transit port in the Far East, and it is also the main point where the cultures of East and West meet. When we appreciate the streets of today's scenic area, the old alleys have been replaced by busy traffic and tourists.

Dasanba Dasanba Scenic Area is surrounded by complex roads. Basuttar Ancient Street and

Nanwan Lakeview Dama Road on its north and south sides are the main urban roads and Xinma Road is an important commercial street. In addition, Shuikengwei Street, Xinsheng Street, and Jinghu Road can also directly lead to the scenic area. Figure 5.
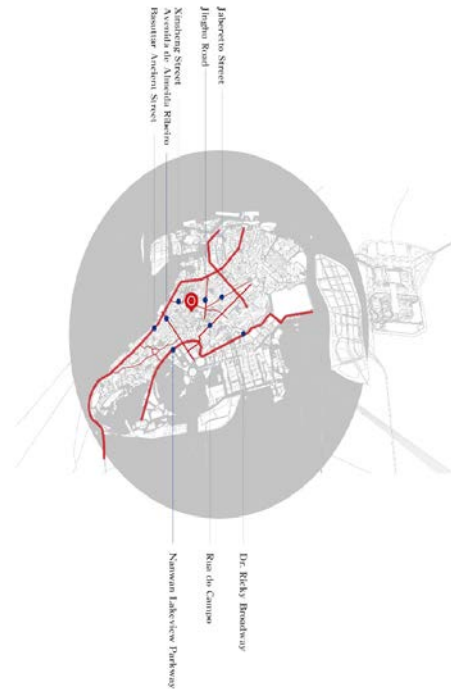

Figure 5 Main roads around the scenic area

In addition to the main streets, the streets, lanes, interiors, and perimeters of the "free-form growth" that have formed over a long period of time are densely scattered around the scenic area. The road surface is narrow and winding, like a maze.

According to on-site survey statistics, the number of tourists who choose to enter the Dasanba Scenic Spot from Xinma Road Fountain Basin Plaza is the largest; the second is from Shuikengwei Street; the number of people who enter the scenic spot from Baige Nest is the least. Figure 6.

Figure 6 Tourists choose to enter the scenic path

Xinma Road, as the city's most prosperous commercial street, carries the functions of a commercial center and the responsibilities of a major arterial road from east to west. It has

convenient transportation, and more than 10 bus routes stop at Xinma Road. Figure 7. The high integration and selection values are the main reasons why most tourists choose to enter the scenic area from Xinma Road.
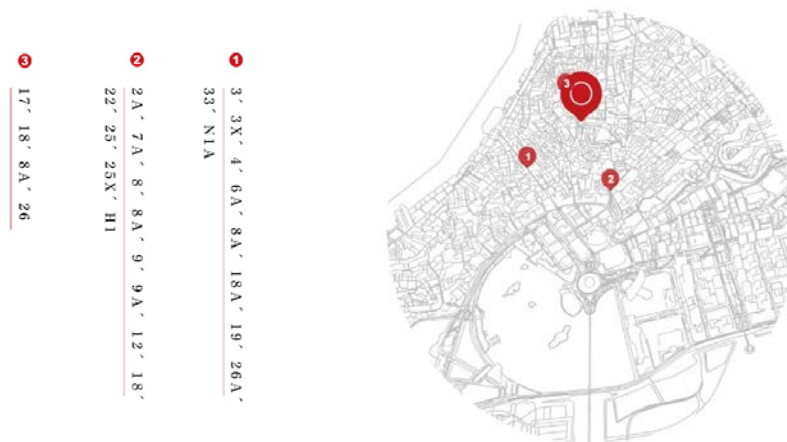

Figure 7 Statistics of buses around the scenic spot

The other two main roads, such as Shuikengwei Street, are also important commercial streets, but their traffic arterial levels are lower than Xinma Road. There is also the front of Baige's Nest, which is located to the north of the scenic spot and is closest to the Dasanba Scenic Area.

From the perspective of the narrow roads such as scenic lanes, perimeters and li, tourists gather more at the intersections of multiple streets and lanes, such as the intersection of Dasanba Street and Dasanba Lane, the intersection of Dasanba Street and Haystack Street . Excluding commercial factors, these streets are highly integrated and selective. Figure 8.

Figure 8 Tourist gathering poin

4. Spatial Visibility and Tourist Behavior Patterns

According to the research purpose, the space of the scenic spot area of Dasanba-Gangding Theater needs to be planarized first. Then use DepthMap software's spatial visibility (Visibility Graph Analysis, VGA for short) to analyze the space visually.

The important reference points involved in spatial visibility in this chapter are Visual Integration, Connectivity, and Isovist.

Visual integration can be understood as starting from a specific element in a spatial system and reaching another element, and the vision needs to be turned several times in total. The fewer the number of turns, the warmer the color (the lowest number of turns is shown in red); the more the number of turns, the cooler the color (the most number of turns is shown in blue).

Spatial visibility (Isovist) can be understood as how much area area can be seen from an element in the spatial system. Viewshed area values are displayed by size from warm (red) to cool (blue). Areas with the same color indicate that the area of view of the element is equal.

Connectivity refers to looking out from one element in the space system and seeing several other elements in total. The more elements you see, the warmer the color is displayed (the maximum value is shown in red), and vice versa.

The data collection in this chapter consists of two parts. First of all, intercept the tourist attractions area of the Grand Samba-Gangding Theater in the Macau city map, as shown in Figure 9. It is made into a vectorized plan view and used as the space syntax analysis base map. See Figure 10 In the spatial visibility analysis, the network scale of the visual analysis is formulated according to the human scale, and the analysis grid will be controlled at about 75cm.
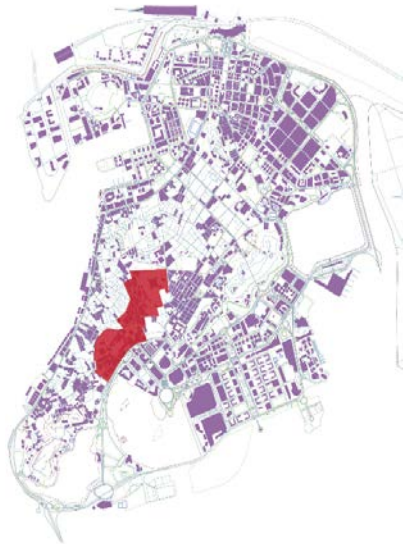

Figure 9 Attraction area of Dasanba-Gangding Theater

Figure 10 Vectorized plan

Secondly, the data collection for the tourist traffic in the scenic area will use a manual statistical method-Gate Method. That is, a virtual doorway is selected at the selected street intersection or street, and the number of tourists passing through the virtual doorway in a certain period of time is recorded.

Choice of bayonet position

After becoming familiar with the space environment of the study area, select the 14 bayonet positions within the area of the attraction in order to record the visitor flow. The setting of the bayonet position should be based on the principle of uniform distribution, and at the same time meet the needs of easy observation. In the research in this chapter, the order of the bayonet numbers is arranged from the front of the museum behind the remnant wall of Dasanba, and is roughly distributed in a strip shape to facilitate the investigation.

According to the observations made during the survey, there are several ways for tourists to visit the attractions: one is guided tours by tour guides; the tours will be conducted in accordance with the routes established by the guides, and the guide is artificial; the second is free walking The way of excursion, the excursion process is highly arbitrary and subjective. This chapter only observes and counts the free-sighted tour behavior, not the tour behavior under the restriction of tour groups.

The method of collecting people flow data is as follows: The collection time of each bayonet is 3 minutes. According to the distance between the Samba bus and the Gangding Theater attractions (820 meters), the total walking time is calculated. Finally, according to the number of bayonet, the

relative the calculation time between two adjacent bayonets is set to be 5 minutes apart. The survey date table 1 is as follows.

Table 1 Survey of Tourist Traffic from Dasanba to Gangding Theater

Time (2018)	the weather	Important festival
5/3	clear	International Labour Day
5/4	clear	N
5/5	clear	N
10/25	clear	N
10/26	Light rain	N
10/27	Light rain	N
10/28	clear	N
10/29	Light rain	N

The walking tour route from the attractions of Dasamba to Gangding Theater is about 820 meters. It goes through Dasamba Street-Takao Street-Mihou Street-Front of the Chamber of Commerce-Suyali Medical Street-Dongfang Xiexiang-Gangding Front Ground. The entire tour route involves the former Sansamba Temple, Nezha Temple, Nvwa Temple, Rose Hall, Renci Hall, Fountain, Post Office, Civil Administration Building, Hedong Library, St. Augustine Church, Gangding Theater Attractions. See Figure 11. Dasanba-the front line of the council is a famous tourist route, the road network is tortuous and dense, and the traffic is huge on holidays. See Figure 12. Although the number of World Heritage-protected buildings on the front line of the General Administration of Civil Affairs Building and Gangding Theater is equivalent to that of the area before the Samba-Council, the traffic flow has dropped significantly, which is in stark contrast to the front of the Chamber across the street.
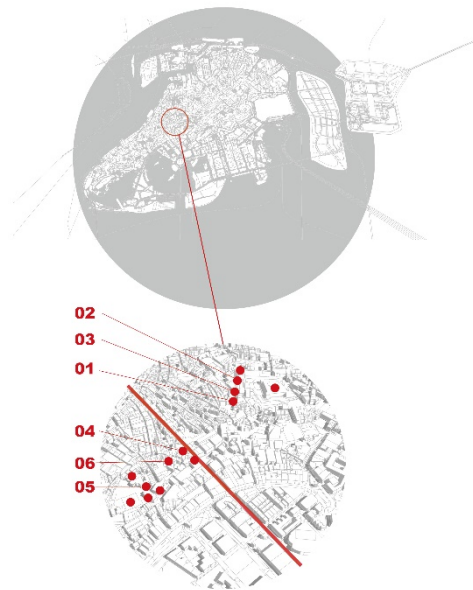

Figure 11 Historic Protected Buildings in Attractions   Figure 12 Dasamba Street during holidays

See Figure 13 for the analysis results of the spatial visibility of the Dasanba-Gangding Theater. Data on the integration of sight, connectivity of sight, and spatial visibility of the two areas of Dasanba and Gangding Theater show significant differences. In the area of Dasamba, many sights, including the ruins of Dasamba and the fortresses, have high-level sight integration areas; however, no high-value sight integration areas have been formed in the post theater.

Connectivit

Isovist

Visual Integration

Figure 13 Analysis of the spatial visibility of the Big Three Bus-Gangding Theater

From the perspective of connectivity and spatial visibility, the value of the Dasanba area is much higher than that of the Gangding Theater. However, if the Xinma Road is taken as the boundary, the line of sight connectivity on the left and right sides is low. That is to say, standing on Xinma Road and looking at the streets on both sides, there is a line of sight obstruction, and the target attractions cannot be seen at a glance. But why does it cause people to rush to the area of Da Samba instead of the fixed area? Excluding factors such as publicity efforts and humanistic traditions, from the perspective of spatial structure, the fundamental reason is reflected in the distribution of the building and the gradient of the slope.

First of all, from the map, a large number of commercial spots are gathered in front of the Chamber above Xinma Road. The various European-style buildings have attracted the attention of tourists to a large extent, as shown in Figure 4-6. At the same time, the distribution of the scenic spots in front of the Chamber of Commerce and the front wall of Dasanba has played a role in guiding the flow of people. From the layout, from the new road, you can see the fountain and the General Post Office. When you enter the Chamber, you can see Renci Hall. Not far away is the Rose Hall. The Rose Hall is the famous food street. From the food street, you can directly see the Dasamba archway, as shown in Figure 4-7. This kind of landscape arrangement is similar to the "step-by-step scene change" technique in garden design, which allows tourists to constantly be stimulated by fresh elements during the tour and guide them all the way to the destination. From the Civil Administration Department building to the Gangding Theater, there is no similar guided attraction in the entire Oriental Inclined Lane. The sights seen by tourists in a long street are relatively single. Second, there is the height difference caused by the mountain. The height difference is not visible on the map. From the field investigation, it can be seen that the road from

300

the front of the Chamber to the remaining wall of Dasanba is flat. In the line from the Civil Administration Department Building to the Gangding Theater, the Oriental Inclined Lane is actually A road leading to the top of the mountain has a large slope, which makes it impossible to see any buildings on the top of the building of the Civil Administration Department, and the sight is severely restricted by the height difference, as shown in Figures 4-8 and 4-9.

Figure 4-6 Front of the Chamber

Figure 4-7 Residual wall of Dasanba

Figure 4-8 Oriental Inclined Lane

Figure 4-9 Buildings on Oriental Inclined Lane

Survey on Touring Behavior Patterns of Big Three Bus and Gangding Theater

Bayonet position distribution

The bayonet position distribution is shown in Figure 4-10. Based on a full pre-survey of the attractions, 14 bayonet positions were selected in the area to observe and record the activities of tourists. The bayonet is located at each intersection, recording the number of people who entered the tour route of Dasanba-gangding. The acquisition time for each bayonet is 3 minutes.
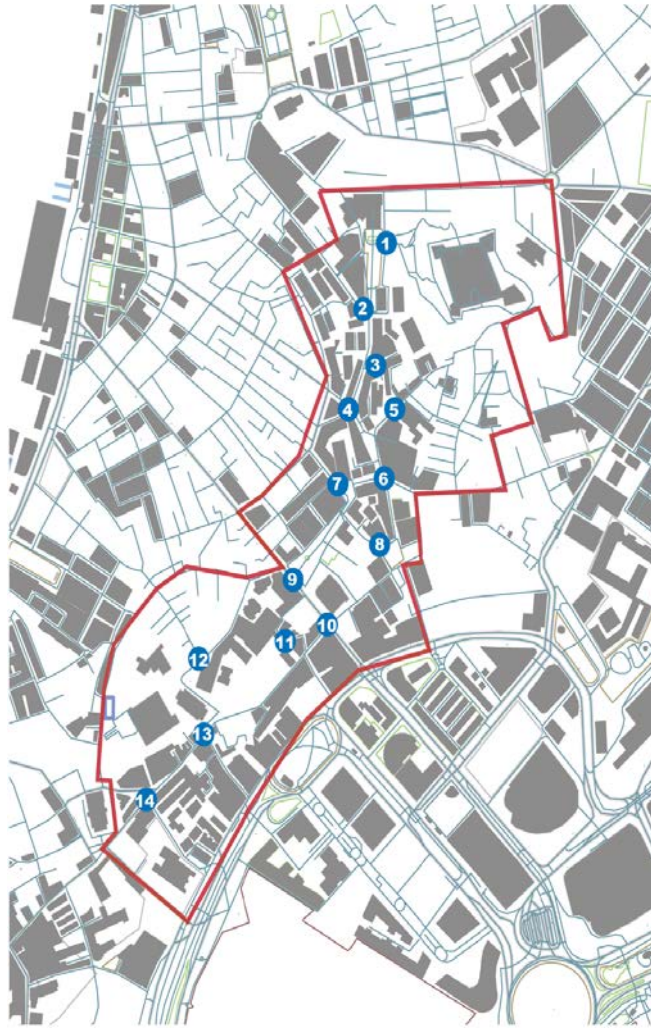
Figure 4-10 Mounting position distribution

The tourist traffic statistics are shown in Figure 4-11. After 8 days of data collection, the number of people in the 14 bayonet counts was 6,485, and the number of people in the Labor Day on May 3 was 1,865, and the remaining 7 workdays were 4,620.
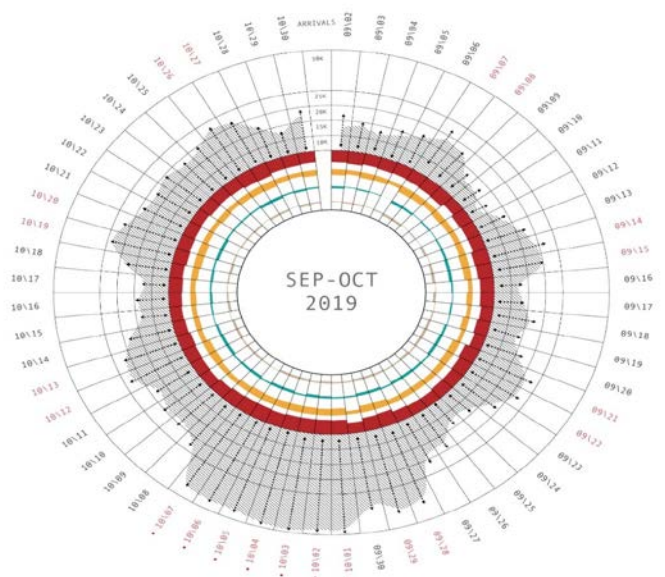

Figure 4-11 Tourist traffic statistics

Correlation between line of sight integration and total visitors

The statistics found that the correlation coefficient between the line of sight integration of the Big Three Bus and the Chamber of Commerce and the total visitor flow was 0.752, while the correlation coefficient between the sight integration of the Civil Affairs Department building and the Gangding Theater and the total visitor flow was $R^2 = 0.568$ (Figures 4-12, 4-13).
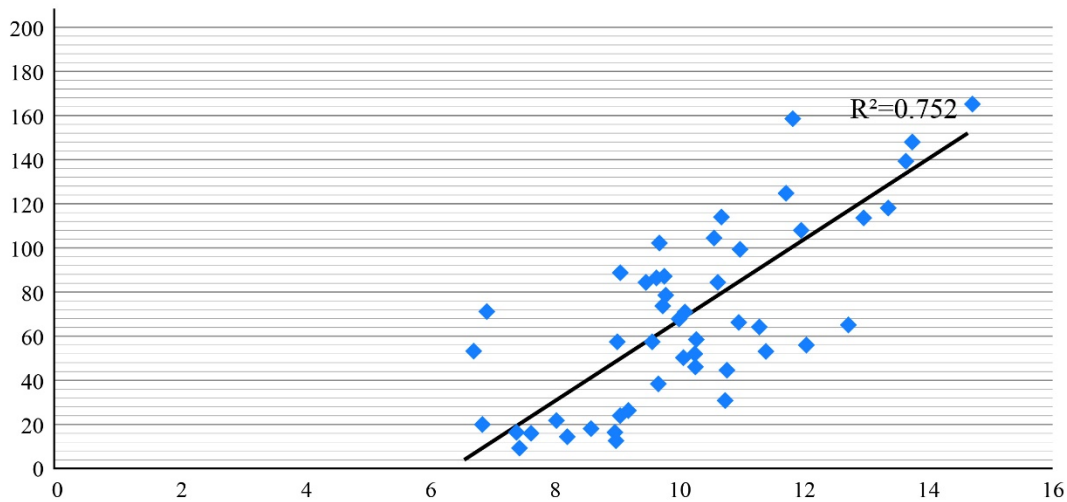

Figure 4-12 Correlation coefficient between the sight integration degree and the total tourist flow in front of the bus
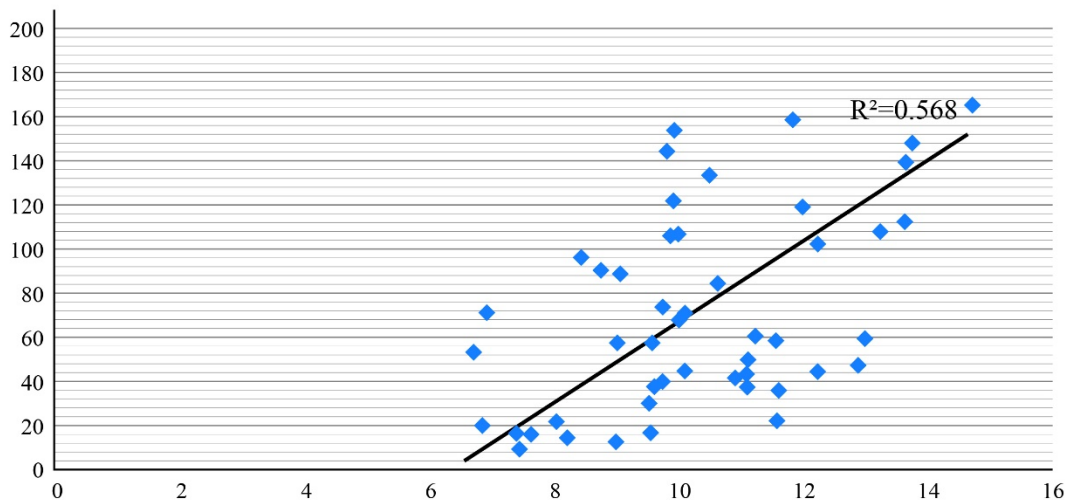

Figure 4-13 Correlation coefficient between line of sight integration of the Civil Affairs Department Building and Gangding Theater and total tourist flow

Correlation between sight integration and holiday tourist traffic

The statistics found that the correlation coefficient between the line of sight integration of the bus and the front desk of the bus and the holiday visitors $R^2 = 0.775$, while the correlation coefficient of the line of sight integration of the Civil Affairs Department building and Gangding Theater with the holiday visitor flow $R^2 = 0.525$ (Figures 4-14, 4-15).
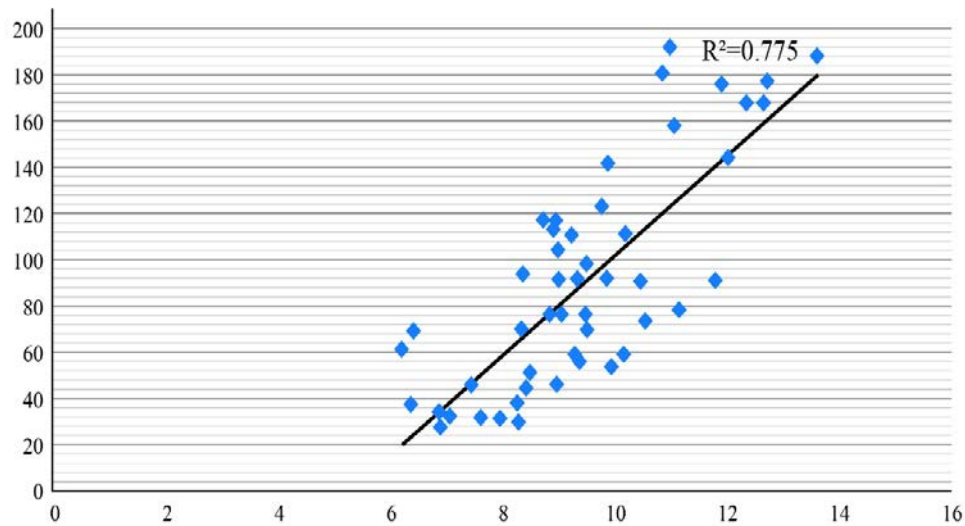
Figure 4-14 Correlation coefficient between the sight integration of the bus and the front of the Senate
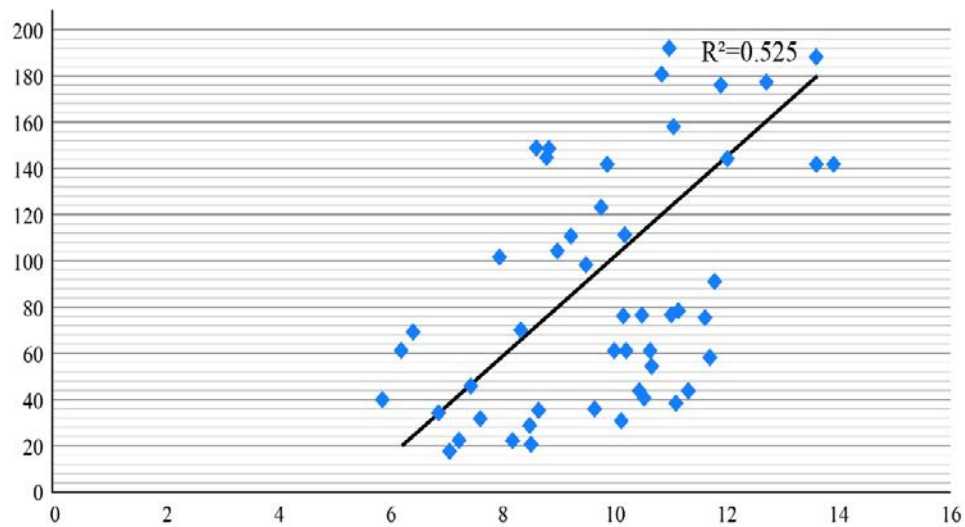and the number of tourists

Figure 4-15 Correlation coefficient between the line of sight of the Civil Administration Department
Building and Gangding Theater and the number of tourists during holidays

Correlation between line of sight integration and weekday visitor flow

Statistics found that the correlation coefficient between the line-of-sight integration of the bus and the front desk of the bus and the number of tourists on workdays $R^2 = 0.603$. The correlation coefficient $R^2 = 0.555$ (Figures 4-16, 4-17).
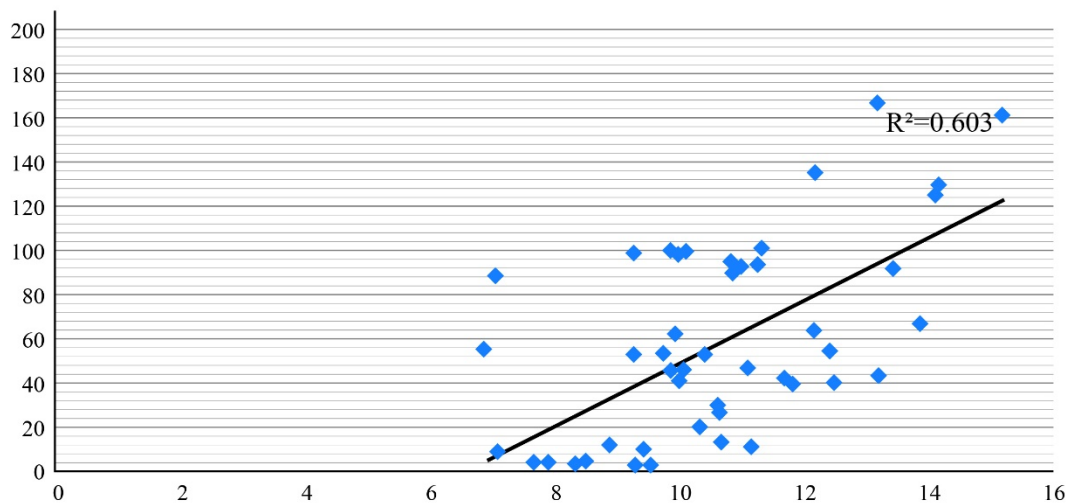
Figure 4-16 Correlation coefficient between the integration of sight between the front row of the Big Three Bus and the Chamber of Commerce and the number of tourists on weekdays
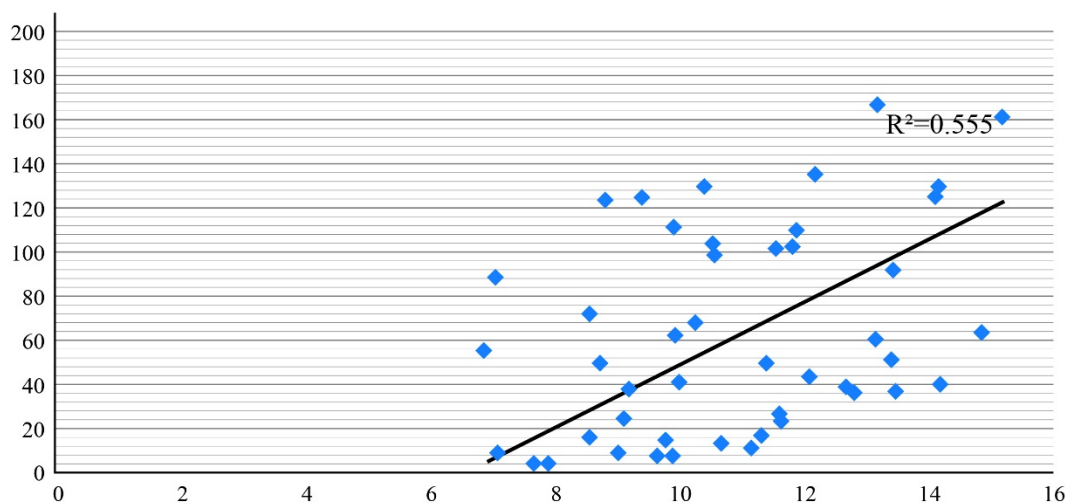

Figure 4-17 Correlation coefficient between line of sight integration of the Civil Affairs Department Building and Gangding Theater and the number of tourists on weekdays

5. Space Competition Rules and Tourist Behavior Patterns

In the analysis of the visitors' behavior pattern of the Dasanba-Gangding Theater above, there is another very obvious problem: the interaction between spatial units. When different directions of space cross each other, it will affect people's perception and cognition of space. This situation is common in urban space. For example, in a city, when a four-lane main road crosses a sidewalk, although there is no line of sight between each other, people in the four-lane and people on the sidewalk recognize their space. Knowledge is different. People on the sidewalk will perceive the street as two different spaces because of the four-lane crossing. That is to say, the road section at this time is a space, and the street at the other end that is divided due to the crossing is another space, resulting in the psychological feeling that the road is separated and cut. Not only that, as people on the sidewalk cross the four lanes and reach the other end of the sidewalk, this feeling will become stronger.

It can be seen that the crossing of two spaces with different directions and obvious differences will cause a deviation in human space perception. If we explain this phenomenon from the standpoint of spatial form, we can conclude that when two road spaces of different masses cross from different directions, large-volume road spaces will affect small-volume spaces. Form spatial

competition. This kind of spatial competition will have an effect on human psychology. The dominant space divides the disadvantaged space and cuts it into two different street spaces. This phenomenon is the law of space competition.

The law of space competition may explain the uneven flow of people at both ends of the Big Three Bus-Gangding Theater from another aspect. See Figure 5-1. It can be seen from the figure that the tourist route of the Dasanba-Gangding Theater is crossed by the Xinma Road, and three spatial units are formed visually, namely the front square of the Senate Hall, the first line of the Xinma Road, and the Oriental Inclined Lane. It can be known from the on-site measurement that the Xinma Road is about 8 meters wide, the ground in front of the Chamber is about 25 meters wide, and the width of the Oriental Inclined Lane is only 3 meters. According to the law of space competition, when different space units cross each other, they will affect each other. The dominant space will divide the disadvantaged space, and the competitive relationship between the spaces formed after the division still exists. Dongfang Xiexiang to Gangding Theater is in a weak position during space competition, leading to the loss of traffic.
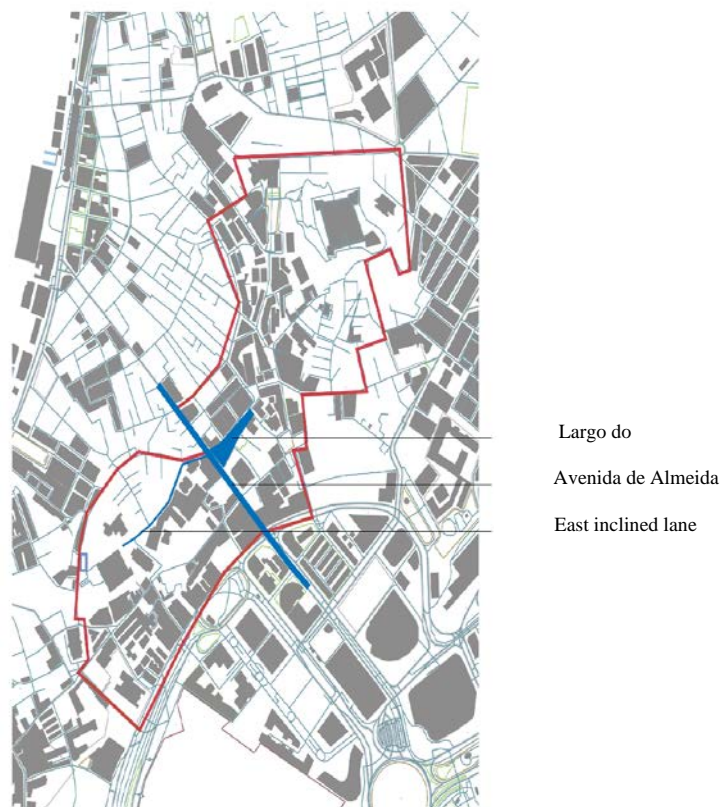

Figure 5-1 Space competition between Big Three Bus and

6. Business Activities Are Distributed in the Tourist Behavior Model

The scenic area is adjacent to the largest commercial center of the city of Macao, and its commercial activities are densely distributed. Xinma Road is the most prosperous commercial street on the peninsula. Hotels, restaurants, jewelry shops, etc. are concentrated on both sides of the street. Although Xinma Road is not a historic street, its important traffic location has made it the area with the most intensive commercial activities. Figure 6-1.

Figure 6-1 Xinmalu Commercial Street

Although the commercial layout around the Dasamba area is not as good as the commercial level of the main road, its catering business is very developed. There are dozens of small and large restaurants and food shops in the alley of about 100 meters. The winding streets lead to the safari walls in the distance, and the winding roads look prosperous and energetic under the squeeze of the retail stores with high density on both sides. Figure 6-2. The ancient roads and commercial formats around the scenic spot perfectly preserve the ancient culture of Macao and reflect the typical characteristics of Macau's traditional culture.
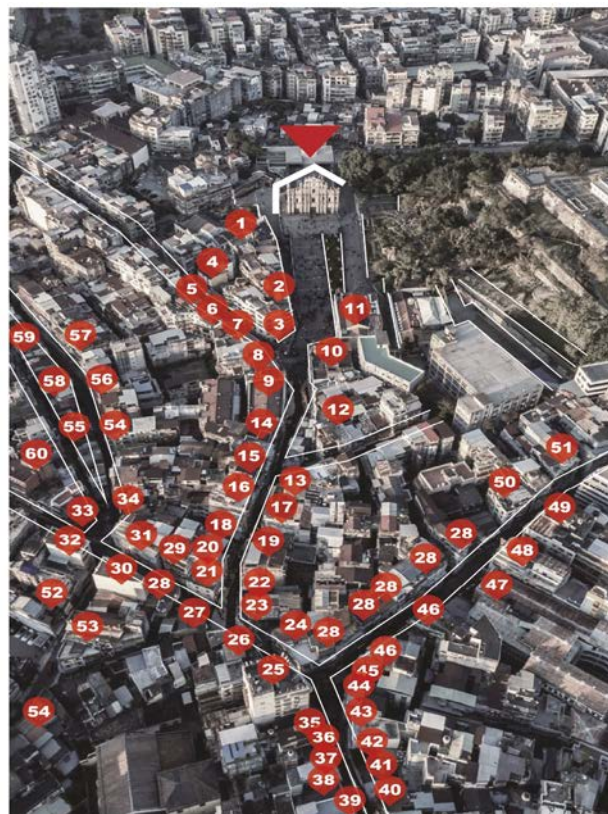

Figure 6-2 Layout of retail businesses around the scenic area

The business surrounding the scenic area also includes the hotel industry and entertainment industry. Macau, known as the entertainment city, is one of the regions with the highest density of hotels in the world. Various hotels and playgrounds of various forms are closely distributed around the scenic area, providing tourists with a relaxing tourist and leisure environment. If you use Dasanba as the radius, you can find the distribution of these hotels: the closer you are to the attractions, the denser the number of hotels. Figure 6-3.
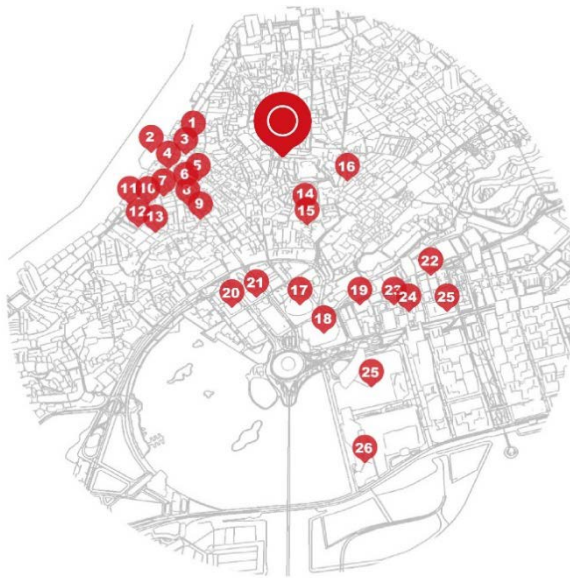

Figure 6-3 Distribution of hotels around attractions

According to the data from the field survey, the incidence of tourists 'shopping behavior is significantly higher than that on weekdays. The shopping time for tourists mainly occurs between 11 noon and 5 pm, with a long duration. Long features.

First, from the survey data, the high-density layout of the hotel industry around the scenic area determines the number of tourists during the holidays. Data from the Macao and Audit Bureau show that during the holidays, hotel occupancy rates near the scenic spot are close to saturation, and often even full.

Secondly, high-density business activities attract a large number of people, and tourists' behavior patterns are not only restricted by road traffic, but also attracted by the bustling and bustling commercial formats. Interestingly, through field survey data, the proportion of women in business-intensive areas such as clothing, jewelry, and jewellery is 69.2, and men are more willing to visit restaurants, museums, churches and other areas.

7. Summary

From the perspective of tourists, tourists' visits and recreational behaviors in urban attractions are not only attracted and visually guided by a series of well-designed attractions in the area, but also restricted by the roads of the attractions.

The analysis of the sight of the Dasanba-Gangding Theater shows that the visual integration, visual connectivity, and spatial visibility (Isovist) within the attractions are highly related to the behavioral patterns of tourists. Although the spatial structure of the attractions will restrict the behavior patterns of tourists, in contrast, the continuous visibility of important nodes in the attractions has a more direct guiding effect on the selection and gathering of tourists' tourist paths, The hints are more intrinsic.

From the statistics of tourists' visitor flow, the visitor flow on a single day during holidays is much higher than that on a normal weekday. Therefore, in the analysis of the correlation between tourist flow and sight, the correlation of a single day on a holiday is more significant. From this, it

can be inferred that the correlation coefficient between the sight conditions of the attractions and the number of tourists will further increase with the increase in the flow of people.

At the same time, during the investigation, it was also found that there was obvious space competition on both sides of Xinma Road in the scenic area. When Xinma Road crossed the front line of the Chamber of Commerce, the Oriental diagonal line, the space on both sides of the road was clearly divided. The ground space has a competitive relationship with the weak space in the Oriental Inclined Lane, which influences the tourists' psychological perception to give them an internal guidance. This also explains the relationship between spatial competition and the flow of people.

The above analysis analyzes the problem of uneven distribution of crowds of attractions in the area of Dasanba-Gangding Theater from both the visual and psychological levels. At the same time, this is also a relevant explanation for the phenomenon mentioned in the introduction.

The sight condition of the scenic spot affects the behavior pattern of tourists. If the sight condition of the scenic spot is improved, the visual perception is improved, and the sight with weak vision is strengthened, then the uneven flow of people in the scenic spot will be relieved.

The red block in Figure 7-1 catches the eyes of tourists and makes people easily discover those hidden and other places of interest.

Figure 7-1 Strengthening the visual

Using the power of modern communications can also solve the problem. Detection devices can be installed around the scenic area to detect the number of tourists in the area. When the number of visitors reaches a certain value, a warning will be issued and displayed to tourists through the travel app. Tourists can view the congestion of the scenic spot in real time through the app, change the itinerary, and can choose other attractions with fewer people through the recommended route of the app.

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