



# Research on the protection and control of architectural landscape view corridor in Macao based on street view image technology

Yuanlong Tan<sup>1,2</sup>

<sup>1</sup> Guangdong University of Science and Technology, Dongguan, China

<sup>2</sup> City University of Macau, Macau, China

\*Corresponding author's e-mail: U21092120241@cityu.mo

**Abstract.** The richness and integrity of the landscape view gallery are determined by its architectural height, architectural style, architectural color, and architectural form and distribution. The protection and control of the landscape view corridor is an effective way to help the overall protection of the historical city, but also a key problem in the practice and research of urban space and an important way to improve the quality of urban space. As one of the world cultural heritage sites, the landscape view corridor of Macao is facing increasingly severe protection and control challenges with the continuous expansion of urbanization process. In this study, the quality of landscape view corridors in 12 different types of landscape spaces was analyzed and evaluated in the historic district of Macau Peninsula, using Baidu Street View images as the main data source, and DeepLabv3+ Street View Image Recognition Analysis and other methods. The results of the study show that: 1) Historic urban areas pay more attention to historical architectural planning indicators and color richness indicators, and do not pay enough attention to the protection of the overall urban landscape viewpoints and height control; 2) The urban building scale density is high, and the commercial and leisure space has a high degree of sky openness, while on the contrary, the sky visibility of architectural and residential space is low; 3) The commercial and leisure space is biased towards tourism experience, and the degree of sky openness, spatial enclosure, and color richness are distributed evenly, but the green and leisure space has a balanced distribution. Color richness distribution is balanced, but the level of green space needs to be improved; in exploring and analyzing the characteristics and problems of the historical cityscape view corridor of Macao, the building height control method is proposed to provide useful references and inspirations for the protection and control of the historical cityscape view corridor of Macao.

**Keywords:** Street view images, Macau, Visual corridor analysis, Protection, Control

## 1 Introduction

The landscape corridor of Macao is an important part of the characteristics of the historical city, which has a certain impact on the living environment and tourism economic development of Macao. The problems of landscape corridor protection and building height control are gradually prominent. With the background of the development of artificial intelligence, we can more accurately obtain semantic information from street image technology, through the selection of macau historic city architecture and landscape space, to explore the present situation of the landscape view gallery, based on street image technology research method can help the protection of landscape view gallery put forward a direction of improvement. Therefore, this paper to the Macao peninsula historical city as the research object, based on the concept of street image analysis and the definition of landscape gallery, analyzes the present situation of the Macao historical city landscape gallery characteristics and problems, discusses the landscape gallery as the core of the Macao peninsula historical city control strategy, puts forward based on the Macao historical city landscape control building height control method. The results show that the combination of publicly available global Google Street View data with artificial intelligence technology will greatly boost the development of urban research.

## 2 Concept definition

Landscape view corridor refers to the line of sight passage between the point of view and the ornamental scenery[1]. Landscape view gallery is not only a basic concept in the urban landscape planning, but also a means of landscape protection in the overall urban planning and development. Open or semi-open landscape corridor in urban planning and design with the main purpose of observing specific objects or environment in specific places. Landscape view gallery is characterized by openness, diversity and interactivity, which can provide diversified and rich visual experience and cultural experience, and is an important part of urban space.

For the historic city of Macao Peninsula, the historical architectural landscape, natural landscape and street landscape are the carriers of cultural characteristics and historical significance of the historic city of Macao Peninsula, and are unique world historical and cultural heritage.

In terms of landscape view corridor, some countries and domestic regions have carried out research, including foreign spindle control methods such as Paris, France[2]And overlooking landscape control in London, UK[3]The protection of historic district has been studied in the landscape gallery, in Hong Kong, Xi'an and Hangzhou, landscape environment protection, landscape sight protection and control. As one of the world heritage sites of the historic city of Macao Peninsula, the height control and sight protection of the buildings in the region, as well as the degree of architectural status and integrity, are the key elements of the preservation and continuation of Macao's historic city.

### 3 Current characteristics and problems of the architectural landscape view corridor in the historic city of Macao Peninsula

#### 3.1 Study scope and study subjects

This paper selects the historical city of Macao which was included in the world heritage in 2005 as the research scope. Macao historic city in Macao peninsula old town as the core, the research object mainly bishop mountain T1 and east at the fort and the lighthouse T2 and big fort T3 landmarks as the highest point, the mazu pavilion, zheng big house, holy old stare with hall, municipal administration hall, benevolence hall, rose hall, the Jesuit memorial square, big fort, three ba memorial arch, virgin snow temple church and lighthouse world heritage buildings, study“Figure 1” the Macao peninsula historical city area of forms, It is an important functional space for local residents to daily live and carry out cultural activities.

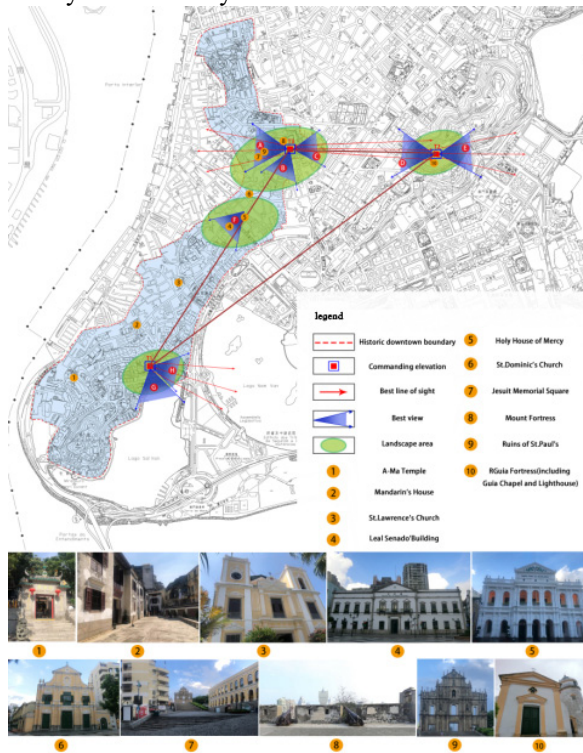


Fig. 1. Current situation of the world heritage buildings in the historic city of Macao Peninsula

Based on the background of "World Heritage culture" and combined with the field investigation of the world heritage architecture status, 8 architectural landscape view corridors were determined "TABLE 1".

**Table 1.** Landscape gallery and view of World Heritage Buildings in Historic City

number	description	type
A	From the big battery to the direction of the inner port	Overlooking the horizon
B	From the big battery in the direction of Bishop Hill	Overlooking the horizon
C	From the big battery to the east of the fort and lighthouse overlooking	Overlooking the horizon
D	From the east of the fort and the lighthouse to the direction of the big fort	Overlooking the horizon
F	In front of the pavilion-Mercy Hall Building-Landscape View corridor of municipal Department Building	Human view gallery
G	From Bishop Hill in the direction of West Bay Lake	Overlooking the horizon

According to the 33rd World Heritage Committee 2009. The contents of Resolution 67, as well as the current laws and regulations of the SAR Government, the long-term implementation of sustainable historical urban renewal and architectural landscape protection measures, propose the above 8 important architectural landscape view corridors that can reflect the value of Macao's historical city.

### 3.2 Research technique

Landscape gallery of protection research need to choose the right index to realize the landscape protection, through the use of frequency analysis of the previous articles on the protection of landscape gallery research are summarized, screening appears the highest frequency of four indicators for street landscape evaluation, respectively is green vision index, sky open index, space enclosed index, color index.

The green visual index represents the coverage of green plants in the landscape space; the sky open index is the proportion of the sky, reflecting the visual permeability of the landscape space; the degree of trees, buildings, fences and other objects; the color richness index reflects the hierarchy and richness of the architectural landscape, which is calculated by the diversity of various elements in the landscape space.

$$\text{Green vision index} = \frac{\text{Area}_{\text{plant}}}{\text{Area}_{\text{sum}}} \times 100\% \quad (1)$$

$$\text{Sky open index} = \frac{\text{Area}_{\text{sky}}}{\text{Area}_{\text{sum}}} \times 100\% \quad (2)$$

$$\text{Space closure index} = \frac{\text{Area}_{\text{plant}} + \text{Area}_{\text{build}} + \text{Area}_{\text{wall}} + \text{Area}_{\text{column}} + \text{Area}_{\text{fence}}}{\text{Area}_{\text{sum}}} \times 100\% \quad (3)$$

Through DeepLabv3 + model, the space photos of the landscape gallery of Macao historical city are obtained, and citiescapes training set is used, and the image recognition accuracy can reach 95%. Then, the values of each index of the landscape gallery are imported into ArcGIS, and the final result of each street is calculated to obtain the distribution characteristics of different types of street landscape.

## **4 Building height control based on the building landscape view control method in the historic city of Macao**

### **4.1 Landscape view control method defines the building landscape control area**

Based on the construction of landscape view control method, in the process of controlling the architectural landscape view corridor of historical city, the most important means is to combine the architectural landscape view control method to delimit the most important landscape control area. On the one hand, the important architectural landscape control area can be built as a landscape view corridor of historical city[4]. This has a direct impact on the quality of the urban landscape corridors; on the other hand, it is the space carrier showing the most world cultural heritage of Macao, which is the area with the most concentrated and dense landscape corridors, including several landscape corridors.

### **4.2 Architectural control idea of the elements of landscape view corridor**

First, the landscape view control method needs to determine the control range of the building height. This can be done by the partitioning of the visual hierarchy of the landscape. Different landscape visual levels also have different requirements for building height, and the limit of building height is determined according to different levels. Secondly, the landscape view control method needs to specify the corresponding height control standard. This mainly includes the total and local restrictions of building height, and gives the corresponding limit values for different building types and uses, and gives the corresponding height control forms according to different land use types and building uses. Finally, the landscape overlooking control method needs to achieve the specific height restriction through different control means. For example, the height of the building can be limited by planning control, architectural design control and so on. Control methods such as total planning amount control, building line control and height ratio control can be adopted to ensure that the building height does not exceed the prescribed limit range.

### **4.3 Height control of landscape view corridor in Macao historic city**

At present, in the existing several planning documents related to the protection of Macao's historic city, According to the document of the Protection and Management

Plan of Macao's Historic City Area, The object of the protection and management of landscape view corridors within the historic urban area.

For the height control of the buildings within the scope of the architectural landscape view corridor in the historic city of Macao, comprehensive control can be combined with the existing landscape view control methods of the three commanding heights, at the overlooking points (T1, T2, T3), the overlooking objects and the scope of visual heritage buildings. The optimal view range is formed by viewing the contour line between the overlooking object and the visual heritage building range “Figure 2”.

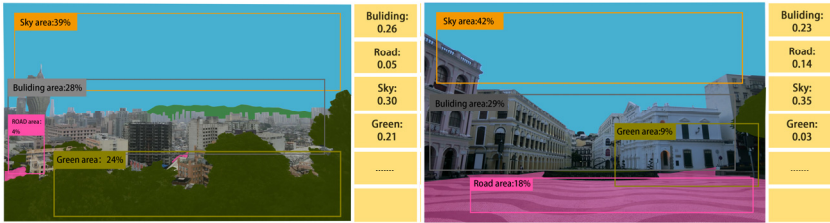


Fig. 2. Current Street View image recognition landscape View corridor analysis

It is generally assumed that, At the highest view point, People can observe the details of a single building within 300 m, The general outline of the urban buildings can be observed within 1500 m, For the strict control of the building height within 1500 m, The distance outside 1500m can be controlled according to the actual situation, Finally, at the point of the circle, Draw circles with radii of 300 m, 600 m, 1 000 m and 1 500 m respectively, Draw five control circles: close scenic area, middle scenic area, far scenic area, visual contour area and visual influence area[5-8]“Figure 3”.

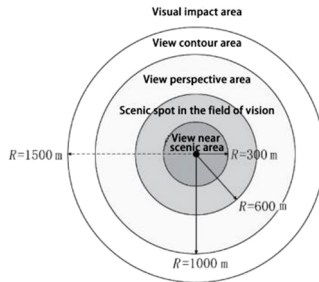


Fig. 3. Height control range around the landscape view point

## 5 Conclusions

Building landscape gallery protection is a complex and systematic work, this study using street map data of Macao historic city building landscape gallery protection and control planning, based on the street map provides quantitative information, at the same time through the scale of different distance of building landscape space height, line of sight coverage, the sky ratio of data analysis to clarify the architectural landscape gallery protection construction system, protect the historical and cultural herit-

age, so as to improve the quality of the city and the quality of public life. In addition, in addition to the study of the history of the city intangible architectural landscape gallery, can also be according to the functional classification of guiding landscape gallery, so in the future study can consider the function classification into the study, summarizes the different function of the architectural landscape distribution characteristics and analysis the corresponding problems, in order to realize the high quality of urban design of landscape space design to provide reference. Therefore, urban architectural landscape visual gallery research will greatly benefit from current and future street image development.

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