

Research on the Spatial Distribution Characteristics of the Customs House in Kwangtung in Modern Times Based on GIS

Mujun Li¹, Qiuming Wang¹, Zhaoming Du¹, Ruirui Huang¹, Jun Chen², Qionglin Liu^{1*}

¹School of Art and Design, Guangdong University of Finance and Economics, Guangzhou, China

²Guangdong Provincial Building Science Architectural Design Institute Co., Ltd., Guangzhou, China

*Corresponding Author.

Abstract:

The Custom House is the core building for the main function of the “Foreign Customs” and the core geographical location of the customs districts in modern China. They are also the most prominent structure in China’s modern treaty port city. The nuclear density, direction distribution, and layout relationships of several Customs Houses in Kwangtung are used to quantitatively analyze their location and spatial distribution characteristics. This research is trying to provide a reference for the historical architecture context in our trade port cities during the contemporary urban construction in China.

Keywords: *Modern Kwangtung (Guangdong), Customs Districts, The Characteristics of Distribution.*

I. INTRODUCTION

That the founding of SHANGHAI Customs in 1854 was the sign of management system of the tax collection agency and information service agency of the China Maritime Customs. The Chinese Maritime Customs Service (Great Qing Imperial Customs Taxation Service) was another name for it. Their business includes supervision, private inspection, handling, and statistics of their own business, as well as concurrent taxation, domestic taxation, maritime affairs, education, and so on.

The Chinese Maritime Customs Service had built the “Foreign Customs” and merged the Native Customs in the opening cities accompanied by the signing of treaty ports. During this time, the Chinese Maritime Customs Service’s Customs and Public Affairs Department constructed customs houses (also known as Customs and Taxation Departments, or Big Bell Tower) in each customs district, as well as several buildings such as Examination sheds, Broker hong, Superintendent’s House, Commissioner’s House, library, residence building for customs foreigners, clubs, and warehouses, and for meeting all kinds of activities. Needs in the above-mentioned customs districts.

In the same way that the customs house in major cities around the world was a symbol of economic prosperity during the great age of navigation, the customs house in modern China's treaty city is a landmark building of the opening city and the core carrier of the customs district in time and space. They have witnessed the changes in foreign trade in the opening cities in the modern century, and have condensed the collective mark of cultural exchanges between China and the West.

In 1936, the modern Kwangtung (Guangdong) Customs developed a complete vertical management system of general customs, sub-customs, and branch offices[1]. A series of customs districts along the coast of Kwangtung Province have combined to form a modern customs spatial system with complete systems, rich levels, and diverse types. These customs districts are cultural heritage groups in the linear areas of the Guangdong-Hong Kong-Macao Greater Bay Area that are linked by modern economic, political, and cultural functions. They, along with the Ancient Post Road in southern Guangdong Province, are both distinct regional cultural heritages in Guangdong. The humanistic spirit unites and integrates the humanistic spirit and material heritage of Guangdong Province's "One Nuclear, One Belt, One District" area. Among them, the customs house was built with the most advanced modern resources at the time, and it was synchronized with the Western world in terms of architectural art and technology.



Fig 1: Distribution map of foreign customs districts in Kwangtung in modern times

In 1936, there were 11 general customs in total along the South China Sea coast of Kwangtung in

modern times (Fig 1[2]), and a total of 102 customs districts have been formed[3]. Except for modern Macau and Hong Kong, each general custom has its own customs house. Because of its functionality, publicity, and landmark status, the customs house has become the most visible building in the customs district. At the same time, due to the particularity of the customs house in economy, trade and national sovereignty, this type of building is the earliest and most complete Western-style building in the treaty port city, and they had a huge and far-reaching impact on the traditional architecture of the opening city. We can develop a greater understanding of the development and evolution of port cities in Guangdong Province in modern times by studying the characteristics of their site layout, and we can provide a reference for the inheritance of the historical spatial context of contemporary urban construction.

II. MATERIALS AND METHODS

2.1 Field of Research and Data Sources

2.1.1 Document-based situation of the customs house

To distinguish it from the New Canton Customs (commonly known as Foreign Customs) that implemented the taxation department system, the Qing government renamed the customs agency originally established in Kwangtung as Canton Customs in the middle of the 19th century. Since then, the Foreign Customs and Native Customs chambers have been established in Kwangtung, the treaty port city. The Foreign Customs was responsible for the supervision and accounting of foreign ship goods that were originally supervised by the Canton Customs, while the civil ship trade is managed by the original Canton Customs agency which has been renamed as the Canton Native Customs. Guangzhou's Customs House of Canton was constructed in 1860. In 1860, the Swatow Customs House was built in Shantou on Mayu Island. The Customs House of Kiungchow was built in Haikou in 1876, the House of Pakhoi in Beihai in 1883, and the House of Lungchow in 1896. There are also customs houses built successively in Wuchow, Sanshui, Kongmoon, and Kwang Chow Wan (Fig 2).



Fig 2: Distribution map of the customs houses in modern Kwangtung

A CNKI search for “modern” and “customs building” yielded 39 documents from 2004 to 2020, far short of the vast historical documents of modern customs and the enormous influence of modern customs in modern times (Fig 3). Simultaneously, there are still few papers on the cultural heritage of Kwangtung customs in modern times. According to incomplete statistics, there were 87 buildings in the Foreign Customs District of Kwangtung in modern times.

There are now 25 buildings left standing, 12 of which are major historical and cultural sites protected at the national level, such as the Canton Customs House, Swatow Customs House, and Kiungchow Customs House; 10 of which are major historical and cultural sites protected at the city level, such as Samshui Customs House; and other buildings and surrounding roads, docks, and auxiliary buildings have been covered by modern roads or building systems and no longer exist. Part of the architectural cultural heritage has neither been counted in time nor has a systematic protection system formed. The purpose of this paper is to investigate the spatial distribution characteristics of the customs house, which represents general customs (Table 1). It analyzes from the port and hinterland perspectives and provides references for the protection and utilization of customs buildings’ cultural heritage, the optimization of urban space, and the sustainable development of urban characteristic culture.

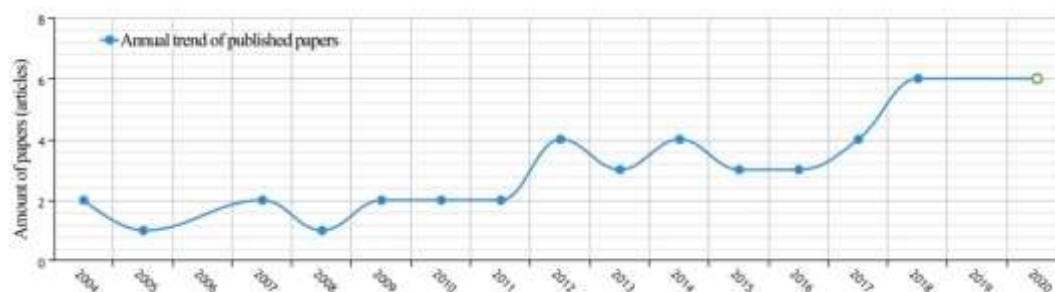


Fig 3: “Modern”“customs architecture”document retrieval and quantitative visualization analysis diagram.
<https://kns.cnki.net/kns/Visualization/VisualCenter.aspx>

In recent years, experts and scholars such as Wu Songdi, Yang Jingmin, Yao Yongchao, etc. have provided outstanding and vast research results on modern Chinese customs. In terms of research content, it primarily focuses on customs history, economy, system, taxation, maritime affairs, and so on; in terms of research methods, it implements most research theories and methods such as sociology, history, and spatial geography. The research provides a good foundation for this paper. Professor Yao Yongchao's definition of the concept of customs cultural heritage, as well as the focus and specific plans for customs cultural heritage research, are particularly inspiring for this research[4]. In short, there are few research results on the architectural cultural heritage of the customs districts from the multidisciplinary perspective of architecture, history, and geography. This thesis employs mathematical graph theory and other research methods to examine the spatial distribution pattern of customs houses in Kwangtung in modern times, to investigate the benefits of customs house location and layout in the development of coastal cities in Guangdong.

2.1.2 Map

There are nine Customs Houses in Kwangtung in modern times. Among them, the modern Leizhou Customs was formally established in 1936. Given that the study includes all customs districts in Kwangtung, the research field for this thesis is the 1936 map of Guangdong Province's administrative boundaries. At the same time, we use the *2015 China Provincial Administrative Boundary Data-Distribution Map of Provinces* provided by the Resource and Environmental Science Data. As the research base map, use the Center of the Chinese Academy of Sciences, and draw the 1936 administrative map of the Republic of China in Guangdong on it, then correct the coordinate system of the base map to WGS1984.

2.1.3 Coordinate data of the customs house

In the records of 11 customs districts in Kwangtung in 1936, the Kowloon and Lappa did not

establish independent office buildings according to the customs records. As a result, the office location in 1936 was used as the analysis value by these two general customs. Rather than clinging to the structure. In terms of geographical location, Lungchow and Wuchow do not belong to the administrative area of contemporary Guangdong Province, but rather to the management of Kwangtung in the modern customs districts, so they are included in the scope of this thesis's comparison.

The construction time of the customs house had been continued from 1860 to 1949. Some customs houses were rebuilt in situ or ex-situ during this time. The Canton Customs House, for example, was rebuilt in 1860, 1872, and 1914[5]. They are all being built under the supervision of Chinese Maritime Customs. In this case, the existing buildings are used as research objects (Table I).

TABLE I. Coordinate data of the customs house in Kwangtung

FID	Customs Establishment Time	The Customs House	X Axis	Y Axis
1	1860	Canton	113.246	23.110
2	1860	Swatow	116.670	23.353
3	1876	Kiungchow	110.337	20.045
4	1883	Pakhai	109.116	21.487
5	1887	Lappa	113.532	22.184
6	1887	Konloon	114.158	22.281
7	1897	Sanchui	112.831	23.162
8	1897	Wuchow	111.321	23.474
9	1889	Lungchow	106.858	22.338
10	1904	Kongmen	113.343	22.607
11	1936	Leichow	110.343	21.278

2.2 Research Methods

2.2.1 Nuclear density analysis

Kernel density analysis is a non-parametric estimation method of spatial point pattern analysis method. It implements a method of gradually transferring the center strength, which can demonstrate the difference in the spatial position of the element as well as the characteristics of the attenuation of the element's center strength with distance. Therefore, the kernel density method is suitable for estimating the density of continuous geographic phenomena such as urban buildings and traffic road risk assessments.

This method uses the sample point's $I(x, y)$ position as the center and calculates the circular area of each sample point within the specified range using the kernel density function, which is a mathematical

function ranging from 1 to 0 from the center to the boundary. This article comprehensively considers the geographic information provided by the Internet and Google,Earth and analyzes the spatial characteristics of GIS in 11 customs houses.

2.2.2 Orientation distribution analysis

Orientation distribution analysis is also called standard deviation ellipse. To form an analysis ellipse, this method starts with the average center and calculates the standard deviation of the point's plane coordinates. The distribution characteristics and distribution area of the data are represented by the long and short axes of the ellipse, respectively, and the center point represents the center position of the entire data. The specific calculation formula is as follows:

$$SDE_x = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n}} \quad (1)$$

$$SDE_y = \sqrt{\frac{\sum_{i=1}^n (y_i - \bar{Y})^2}{n}} \quad (2)$$

The standard deviation ellipse analysis tool is used to analyze data from different districts to further analyze the scale, distribution characteristics, and distribution trends of the House. The first-level ellipse is used, which covers 68% of the point data. The analysis results are shown in Table II.

TABLE II. Data sheet of the ellipse parameters of four customs houses

No.	The Name of Customs	X Axis Standard Distance/m	Y Axis Standard Distance/m	Rotation
1	Konloon	25102.79204	96799.94518	77.126472
2	Lappa	24329.20762	5009.555243	163.366011
3	Leichow	39417.58755	66528.70681	33.21606
4	Kiungchow	69373.99472	5930.582052	163.055424

2.2.3 Site analysis

Using the House as the focal point, it intercepts a 1,000-meter square area centered on the Customs Office building and analyzes the distance between the site's land and water.

2.3 Research Steps

Historical documents, modern maritime maps, and geographic information were used to create the database for the modern Kwangtung Customs House. The following is the flow chart of the study (Fig 4).

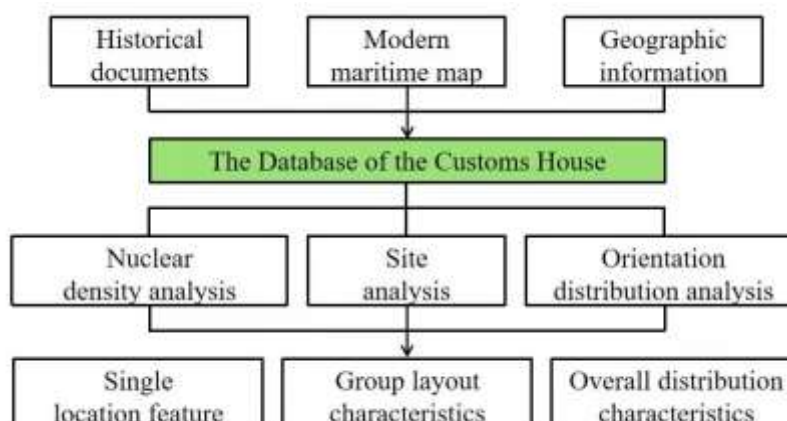


Fig 4: Research process diagram

III. DISCUSSION

This study examines the characteristics of the customs house site layout based on the relationship between a single building and the site, the relationship between the geographical locations of multiple customs districts, and the overall layout of the nine buildings in Kwangtung.

3.1 Principles of Building Site Selection was “Shipping First”

The customs house site was chosen based on an analysis of historical documents, modern nautical charts, and geographic information, and it reflects the principle of “shipping first.” The location of the House was prioritized by the location close to the waterfront (Fig 5).

For example, the site selection of the Hekou House in Samshui prompts “The important point of the all complex, the shipping was first,” and is set up at the intersection of public waters and convenient waterway traffic. Another example is the site selection of the Canton Customs House, which remained at the Qing Dynasty’s rear entrance [6]. It was located on the Pearl River’s shore and had a continuous relationship with the thirteen Factories District [7]. When the Canton House was rebuilt in 1914, the ships mainly managed Chinese and foreign merchants and large ships, tugs, and tugs. The working distance between the telescope and the inspection factory is defined by the business of transporting goods and collecting taxes. The inspection factory is built along the river, and the House is 150 meters

from the Pearl River's bank (Fig 6). The customs house and the inspection plant jointly form the connection and transitional space between land and river.

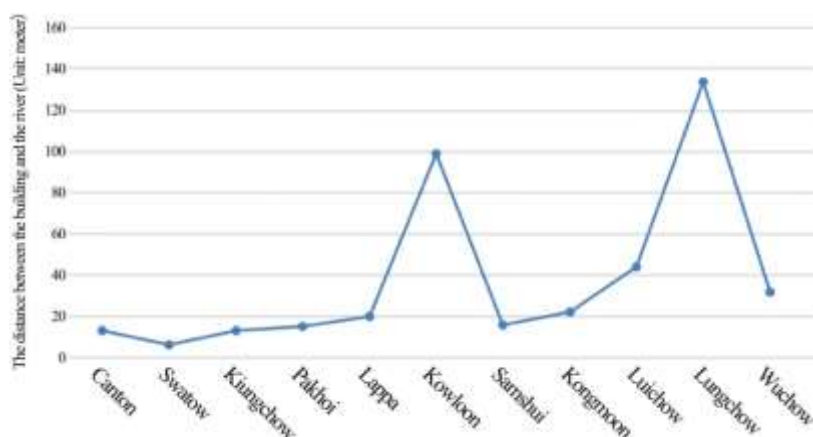


Fig 5: Columnar analysis diagram of the distance between the house and river

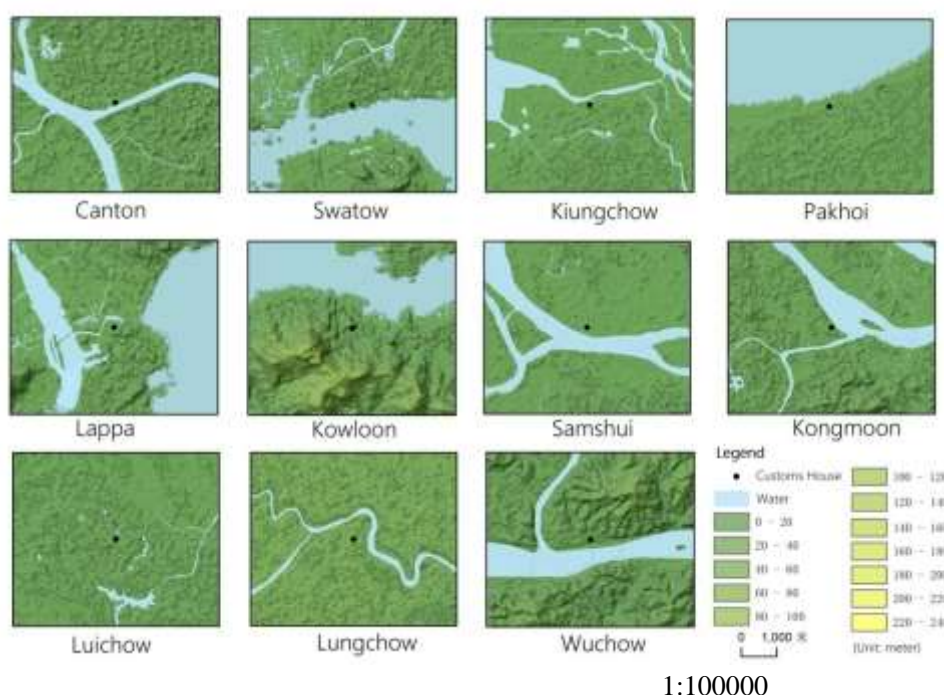


Fig 6: Direction between the location of the houses and rivers

3.2 The Layout Characteristics of the Customs District of “The Form of two Horns Facing Each Other”

The customs house was the focal point of the “Foreign Customs” district, and its location

determined the geographic spatial positioning of the entire customs district along Kwangtung's coast. Following the Opium War, China entered the international capital market as a self-sufficient agricultural economy driven by Western maritime hegemony, gradually transitioning from a continental to a land and sea country. Alfred Thayer, a pioneer of modern sea power thought, believes that sea power, especially the control of strategically significant narrow waterways was very important to the status of a big country[8], and geographical location is the first of the six major factors in his sea power theory.

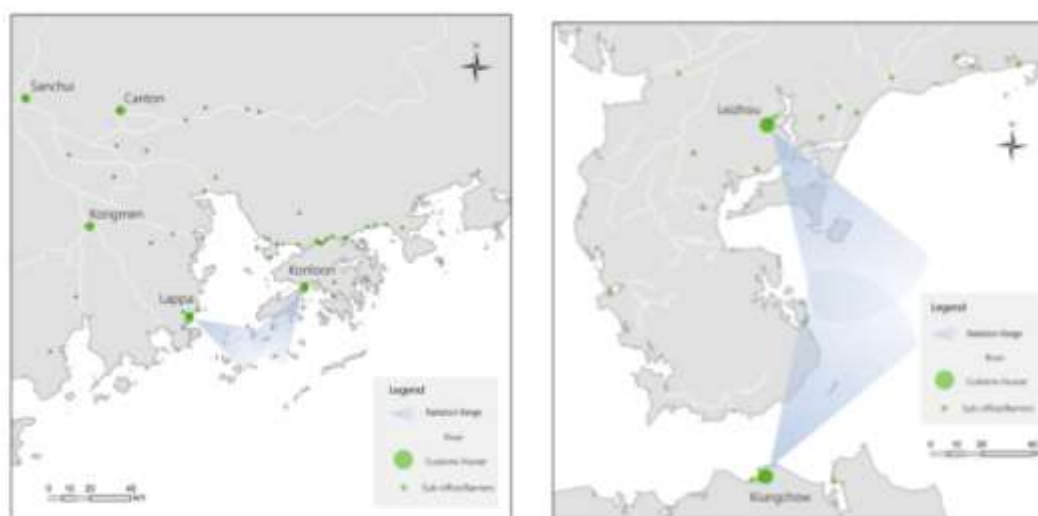


Fig 7: One of the form of two horns (Lappa and Konloon) facing each other

Fig 8: One of the form of two horns (Leizhou and Kiungchow) facing each other

The force of horns was originally intended to attack the enemy from two sides, but it has since become a metaphor for cooperating and attacking the opponent in a war. This type of architectural layout with the cornering relationship in the water space is suitable to the customs system's dominant position in space for inland and sea resources, and it has the dual benefits of the sea and land coordination in the economic and geographical structure.

For example, Lappa and Konloon are horns facing the South China Sea at the mouth of the Pearl River (Fig 7); Leizhou and Kiungchow are horned to strangle the Qiongzhou Strait between Leizhou Peninsula and Hainan Island (Fig 8).

3.3 Districts homogeneously Distributed in the Coastal Area

The three-level ellipses represent the ellipses that can contain 68%, 95%, and 99% of the three-level data (Fig 9 and Fig 10). The semimajor axis of 68% of ellipses is 354,743.22 (unit: meter), the semiminor axis is 93675.64, and there is a fourfold difference between the semimajor axis and the minor

axis. The coastal distribution of 102 customs districts is concentrated in the Pearl River Delta Estuary, Swatow, and Qiongzhou Strait, according to images of 11 general customs, 81 sub-customs, and 10 branch offices. The 11 foreign customs districts are homogeneously distributed along the coastline of Kwangtung, and the largest number of customs districts are distributed in the Pearl River estuary. This corresponds to the port's economic prosperity distribution's spatial axis. It also demonstrates that the concentration of buildings in the research area is related to the economic distribution of the population, with the gathering points remaining relatively consistent.

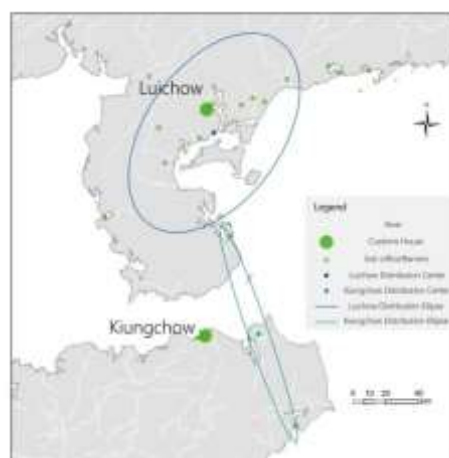


Fig 9: Ellipses of Lappa and Konloon Fig 10: Ellipses of Leizhou and Kiungchow

IV. CONCLUSION

The modern customs house was the center of the modern foreign customs districts' politics, economy, and culture. The entire customs area had been developed, including its functions and space areas, with the House serving as the focal point. Therefore, the characteristics of the customs house can deduce the layout characteristics of the modern customs districts. As a result, this article employs nuclear analysis, direction distribution analysis, site analysis, and other techniques to discover that the first principle of House distribution in modern times is "first shipping" in the customs localities of Kwangtung; the second is that each customs district has developed "the form of two horns facing each other"; and the third characteristics of uniform distribution along the coastline of each Customs.

Modern customs buildings in Kwangtung were mostly located at the geographic intersection of specific environment and land environment, and the House was carried out horizontally along the river. In modern Kwangtung, the 102 customs districts of the architectural settlement system and lighthouse buildings, modern transportation system, and transportation system post-transmission system, river and sea, etc. have constructed a complete system, rich levels, and type of modern story space system

stereotypes together.

ACKNOWLEDGMENTS

This research was supported by 2021 Guangdong Province (China) Lingnan Cultural Project: *Research on the Cultural Heritage System and Protection of the Customs Districts of Lingnan in Modern Times* (Grant No. GD21LN04).

REFERENCES

- [1] Wu S D, Yang Y Y (2017) An Analysis of the Spatial Structure Changes of the Customs Customs Area-Focusing on the Coast of Modern Guangdong. *Journal of Yunnan University (Social Science Edition)*, Issue 01, p. 65-73.
- [2] Liu Q L, Chen Y H, Chen S Y (2020) Spatial distribution characteristics of Foreign Customs Districts in Kwangtung(Guangdong) Province based on geographic information system(1842–1949). *IOP Conference Series: Earth and Environmental Science*, 2020-11-07.
- [3] (2002) The Local History Compilation Committee of Guangdong Province. *Guangdong Province-Customs History*. Guangzhou: Guangdong People's Publishing House, p. 67.
- [4] Yao Y C, Zheng W Z (2012) Preliminary Research on Customs Cultural Heritage. Shanghai: Journal of Shanghai Customs University, 2012-04. P. 7-10.
- [5] Fu J, Cai Y, Liu Q L (2014) Looking at the development of modern Chinese Customs Architecture from the replacement of Canton Customs House. Beijing: *Journal of Ancient Architecture and Landscape Technology*, p. 66-73.
- [6] (1903) The Second Historical Archives of China, the General Office of the General Administration of Customs of China. *Chinese Old Customs Historical Materials*, Volume 38, Beijing: Jinghua Publishing House, p. 297.
- [7] Liang T Z, yuè hǎi guān zhì (2002) Guangzhou: Guangdong People's Publishing House, p. 63.
- [8] Mahan Alfred Thayer (1987) *The Influence of Sea Power Upon History: 1660-1783*. New York : Dover Publications.