

# Research on Spatial Distribution of Modern Commercial Buildings in Guangzhou Based on GIS

ShaoBin Wang<sup>1,2</sup>, QiongLin Liu<sup>2\*</sup>

<sup>1</sup> Tianjin University School of Architecture, Tianjin City, 300072, China

<sup>2</sup> Art and Design School, Guangdong University of Finance & Economics, Changzhou, Guangdong Province, 510320, China

\*Corresponding author's e-mail: L@gdufe.cn

**Abstract.** Based on the translation of the historical maps of cities, this paper sorts out the distribution information of various commercial buildings in Guangzhou during 19th century, and establishes a database of commercial buildings in Guangzhou in the 19th century with spatial information technology to show the distribution of various commercial buildings in this city. Moreover, this paper uses GIS to process pairing and density comparison analysis from various sources, which reveal the evolution characteristics, and impetus factors, of commercial buildings in Guangzhou from the formation and factors of urban commercial buildings spatial pattern. Finally, this paper provides countermeasures for the protection of contemporary Guangzhou city, commercial and trade buildings, in the context of rapid urbanization.

## 1. Introduction

Development of modern China has shifted from the early stage of urbanization which emphasizes economic growth to the middle stage which pays more attention to cultural development. Urban culture has become an important social capital to support and determine the urban development process. With the development of cultural city strategy in Western cities, and China's increasingly calm thinking about GDP growth, requires increasing attention to urban culture. Urban culture-based competitiveness, has become a major point of competition among cities, and has gradually become the core issue of the rapid urban process.

Cities can be termed as a kind of social economic natural complex ecosystem, dominated by human activities. Under the introduction of modern materials, new energy and innovating information technology, the energy and structure of the city are constantly developing and mutating, promoting the transformation of urban form and structure, and achieving a stable and orderly state at a new level, and form a process of "fluctuation and order". The urban pattern has certain tolerance to the change of society and economy. When the energy accumulation breaks through the existing balance, the pattern will produce adaptive changes, and will continue to reach a new balance in the relationship between people, land and building. If the urban pattern can maintain relative stability and continuity, the city's spirit, culture and personality will be maximized to inherit and self-renew, forming a sustainable competitiveness.

The construction and development of Guangzhou's cities in China is closely linked to the international situation, the rise and fall of the country, and its social development. The commercial building pattern and cultural heritage in the urban context of Guangzhou, is an important part of Guangzhou's millennium business capital, and it is also the most inherent and self-renewable part of



urban culture and urban spirit.

Under the strong forces that exist, which may necessarily cause a collision between traditional culture, and foreign culture, Guangzhou has rapidly changed from a closed, inward and trade-oriented city to an open, outward-oriented and a very comprehensive city internationally. The end of the self-sufficient urban cultural system in Guangzhou, in the pre-Qing Dynasty, and the birth of the new Guangzhou urban cultural system, adopting the new wave of world economic development, have made it necessary to form a multilayered development strategy. In this urban pattern, the world's shipping and trading center, such as the Huangpu Port, the world's thirteen-hongs commercial district, and the community of wealthy competing merchants in Xiguan (Weatside), etc., this initiative followed the development process of ancient and modern, reflecting the continuation of the historical context, and laying the rudiments of the current urban pattern that we see today. In this process of urbanization, the commercial buildings from the late Qing dynasty, to the early years of the Republic of China, were the main remaining structural body of Guangzhou commercial buildings over the years, which is also an important space carried forward and integrated into the modern business culture.

The urban trade pattern of Guangzhou is formed by the development of the commercial and trade industry, and the prominent pattern of modern city trade, that is the pattern of a "business cycle", which appeared once modern trade relations were established. Through the research on the formation and development of Guangzhou's modern commercial and trade building pattern, this paper explores the evolution of the main characteristics of the urban development pattern, and provides reference for the sustainable growth of urban building culture in Guangzhou and other similar Chinese cities.

## **2. Spatial and temporal scope, data sources and research methods**

### *2.1 Spatial scope*

The development of Guangzhou has obvious uniqueness compared with most traditional cities in China, both inside and outside of the city wall, and both entities subsist and prosper together. In the Qing dynasty, the development outside the Guangzhou city wall was mainly the foreign trade area in the South of Westside (Xiguan). Outside the West Gate of the city, the industrial area was dominated by the machine house area in the North of the West Gate. The residential area was at the West side of the West Gate. Two large prosperous areas were formed along the riverside of the Pearl River, namely, the Southside (Nanguan) area on the north bank, and the Henan area on the south bank (Figure 1).

The geographical scope of modern Guangzhou which is described in this paper, includes the inner city, Eastside, Southside and Westside, and the riverside area in Henan (south bank of pearl river) (Figure 2) in Qing dynasty. At the end of the Qing dynasty and the beginning of the republic of China, this whole area was the fastest growing urban settlement in the early Qing Dynasty, and became the focus of such this research.



Fig.1 Guangdong City map

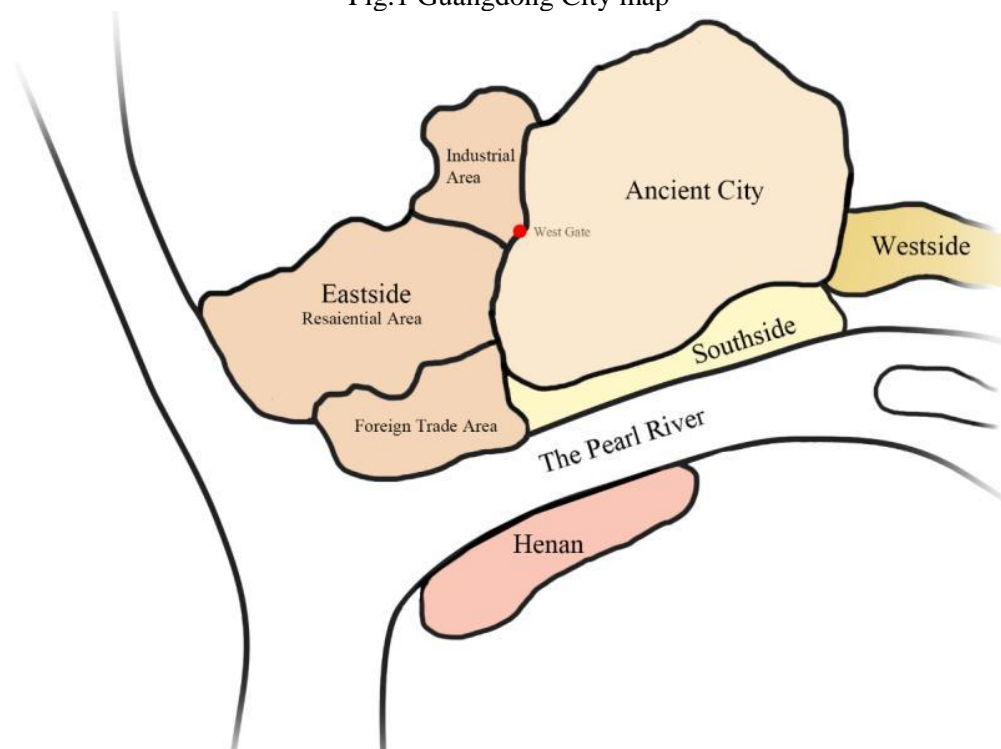


Fig.2 Sketch map of commercial buildings in Guangzhou City in the Qing Dynasty

2.2 Temporal scope

This paper draws on the history of early building methods to define the time scope of "modern times" and selects the period from the Opium War to the period of 1949 as the research period. Most of the existing traditional Lingnan buildings in Guangzhou were built after 1840. In the early 20th century,

Guangzhou built neoclassical modern Western-style commercial buildings. And in 1911-1938, Guangzhou carried out large-scale urban reconstruction and redevelopment, and focused on developing new modern Western-style commercial buildings.

### 2.3 Research methods

On the basis of translating the historical map of the city, this paper clarifies the spatial information and distribution of the various commercial buildings in Guangzhou in the 19th century. It uses the spatial information technology to establish the 19th century Guangzhou city commercial and trade building culture database, which is intuitively presented. To analyze the distribution status of various commercial buildings and patterns, we have used the help of GIS to achieve a more in depth analyses. With this analyses, and other information obtained, and with further discussions we begin to form the urban trade pattern from intensive, economic, central and social, which then reveals the Guangzhou city trade. This reveals the evolutionary characteristics and dynamic mechanism of Guangzhou city trade culture.

### 3. GIS analysis of the factors affecting the distribution of modern commercial buildings in Guangzhou

Based on the buildings and urban area of the 《Detailed Streets Map of Guangzhou》 in 1948, according to the geographical and time information of modern commercial buildings provided by historical documents such as 《Guangzhou City Defense Record》, and 《Guangzhou City Record》, which compiled digital database of modern Guangzhou commercial buildings, the data in the database is classified according to Western-style buildings such as customs, foreign firms, department stores, banks, hotels, and Lingnan-traditional buildings such as shops, local theatres and bazaars. According to the geographical location of each type of building, it has been drawn by CAD with the data type of the point. After that, it uses ArcGIS software to import the various elements in the dwg file in AutoCAD format into GIS data, and construct the GIS database of the spatial distribution of commercial buildings in modern Guangzhou (Table 1).

The attributed fields in the database are listed with name, type, address, creator, start time, and so on. The time attributed can be used to show the distribution and quantity changes of commercial buildings in different historical periods. The core issue of GIS for the development of urban landscape includes five aspects: location, conditions, trends, patterns and models.

Table 1 Work flowchart



#### 3.1 Surveying and research of buildings

Surveying and researching the physical environment and related social and economic attributes in the urban space of Guangzhou, including collecting data from historical periods, and establishing commercial architectural texts and photo libraries based on geospatial systems.

An object or entity must accord with three conditions to be positioned: it can be identified, it is important (related to the different problems), and it can be described (with features). When a geographic feature is embedded in a European space, it will form three types of feature objects: point, line, and polygon. In this study, the point object is the main research, that is, an object with a specific position and zero dimension is used for positioning annotation. This topic selected 79 buildings from 1842 to 1949, including 7 department stores, 11 banks, 6 hotels, 16 foreign firms, 7 customs building, 15 tea houses and 10 post offices.

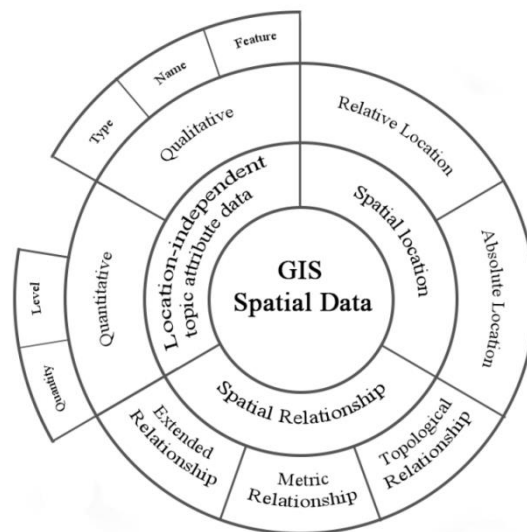
#### 3.2 Building characteristics

The spatial data of GIS has three types: spatial location, spatial relationship and location-independent

topic attribute data (including time attributes). The first two belong to the positioning data, and the third one belongs to the non-positioning data.

The spatial location is the spatial location of the buildings in the city, including absolute and relative locations. The spatial relationship has three geometric logic relationships: metric relationship (far or nearby), extended relationship (azimuth), and topological relationship (the constituent relationship between boundary and entity). These spatial relationships are reflected in the urban pattern as spatial layout, spatial form layout, enveloping relationship, streamline organization, street water network pattern, open space system and other morphological layout features (Table 2).

Table 2 GIS spatial data composition diagram



Thematic attributes are geographical variables or geographic meanings associated with building entities and can be obtained by classification, naming, measurement, and statistics. Attributes are divided into qualitative and quantitative, the former includes name, type, characteristics, etc., and the latter includes quantity and level. This study uses age and function as attributes of geographic entities. Qualitatively and quantitatively measure, analyze and determine the characteristics of commercial buildings that existed in the city. Through the association of spatial location and spatial relationship, the spatial map of the distribution and evolution of urban commercial buildings can be obtained.

### 3.3 Data calculation and analysis

The layout of the buildings is based on the basic elements of the building, which visually shows the distribution of buildings in different ages and functions within the block. Comprehensively used GIS spatial analysis method to analyze and calculate the spatial characteristics and indicators of urban commercial building pattern through the basic data platform, such as buildings layout, clarity, functional composition, density, fineness and so on.

On the basis of comparing the characteristic indicators, combined with the comprehensive speculation of the historical literature and the status of the social composite system, the historical evolution process and influencing factors of the urban commercial and trade building pattern are analyzed and studied.

## 4. Characteristics and Influencing Factors of Modern Commercial Buildings in Guangzhou

The development of China's marine industry has affected the character and function of Guangzhou. The traditional commercial space in Guangzhou is near the West Gate of the city and near the East Gate of the city. The modern business district has continued in the location of the traditional commercial district to a certain extent, and at the same time, due to modern commerce is extremely dependent on transportation. The business group mainly develops along the Pearl River by clusters,

and this kind of developmental distribution exists in other concession cities. According to the Kernel Density Analysis (Fig.3), three conclusions can be drawn: First, the city forms three modern trade zones: Beijing Road Business District, Shangxiajiu Business District, and Yanjiang Road Business District; Second, Yanjiang Road Business District, in the three business districts, is the most prosperous and most systematic business group in the city. It has buildings of most diverse, most numerous and the closest distance (Fig.4, Fig.5). Third, the development of the Yanjiang Road business district on the north bank of the Pearl River is from West to East along the banks of the Pearl River (Fig.6).

Modern commercial buildings are mainly concentrated in the two sides of the Pearl River estuary: Shamian Island, and in the North bank of the Pearl River. Based on the aforementioned historical documents, and GIS databases, the core density analysis of urban spatial elements (the radius of the element search is 1km), comparing spatial relationships between these spatial elements, can be seen that the distribution of commercial buildings is mainly affected by the following factors.

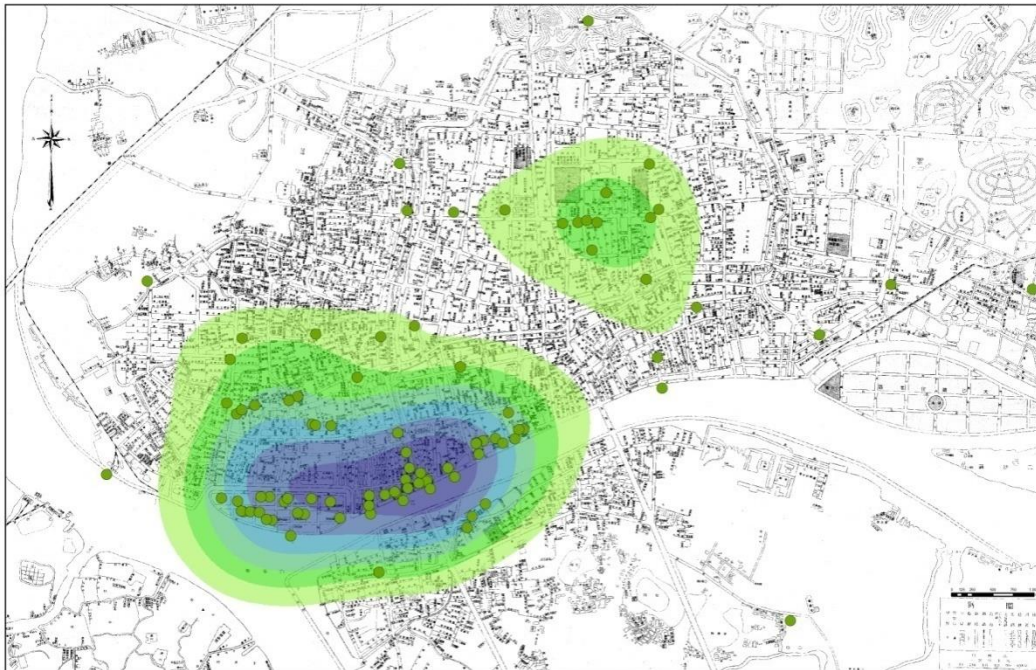


Fig.3 Distribution of modern commercial buildings in Guangzhou

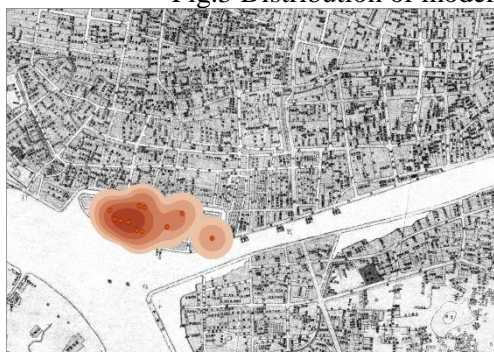


Fig.4 the Kernel Density analysis of Foreign Firms



Fig.5 the Kernel Density analysis of department buildings

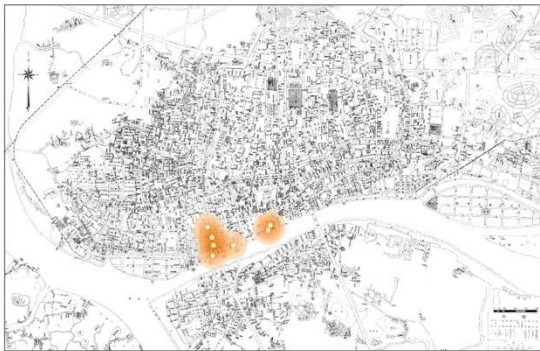


Fig.6 the Kernel Density analysis of financial building

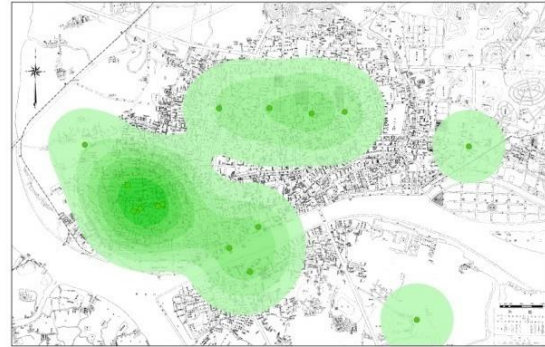


Fig.7 the Kernel Density analysis of catering building

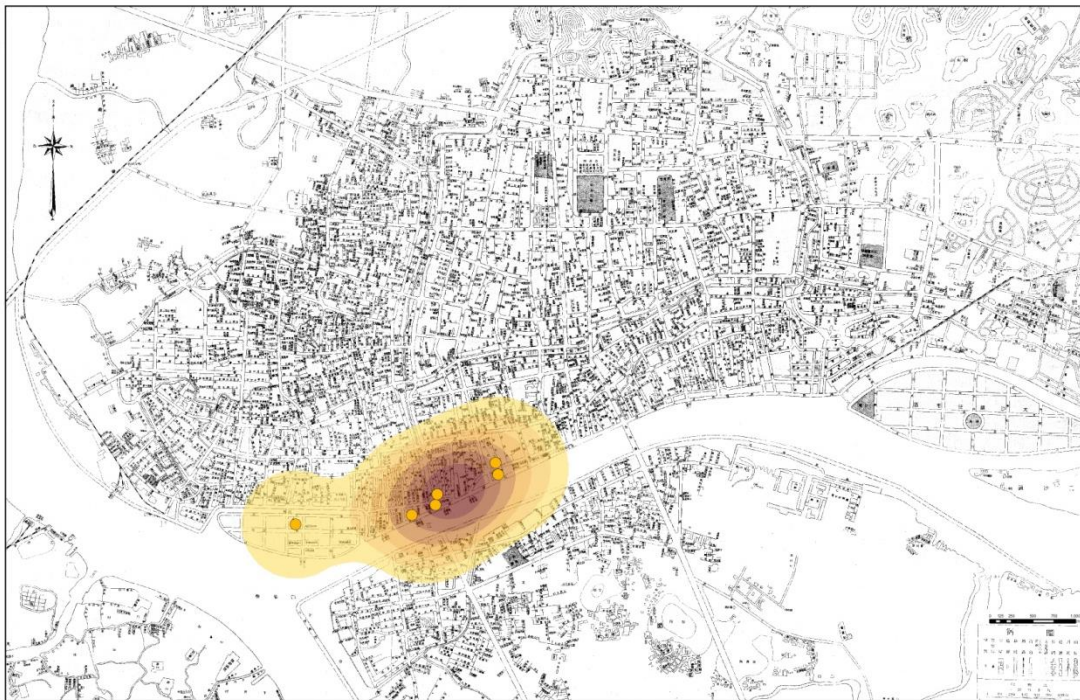


Fig.8 the Kernel Density analysis of hotel building

#### 4.1 Impact of rivers on city business pattern

Since the late Qing Dynasty, the connection between market and domestic in Guangzhou city, was mainly transported by sea. The low-cost mode of transportation with the traditional waterways and seaways, facilitated the development and circulation of commodity economies. As the sediments of the West River, the North River, and the upper reaches of the East River in the Pearl River Basin continue to be narrowed, the river transport capacity gradually declined, and urban transport begins to rely on new industrial technologies such as automobiles, trains and airplanes.

The Yanjiang Road is connected to the pier, railway station, etc (Fig.7) . From the Kernel Density Analysis of customs, foreign firms, banks, department stores, theaters, and hotel buildings, it can be seen that the business district along Yanjiang Road has a high density distributed area of commercial buildings. The commercial structures are centered on important buildings such as, Da Sun. Co .Ltd Building outside the city, Guangdong Customs, and Oi Kwan Hotel. They form a number of different

levels/types of commercial buildings and expand along a certain direction and distance to form certain geographical boundaries seen in (Fig.8) . In the business circle, there is a strong interaction, and close connection, between the buildings which form a high-density area of urban commerce. The district's organization and management activities, is in the process of obtaining a certain amount and quality of products and services and other achievements, which will consume less resources than other business districts, and thus having high scales of economy. This zone mode has a high degree of centrality, and uses the basic properties that are beneficial to the overall development of the city.

#### *4.2 Impact of traffic on city business pattern*

The superior geographical location, and the developed and convenient water and land transportation, are the main conditions for the formation of the business district. The city located in the domestic water and land transportation hub forms a domestic commercial center with its superior traffic location. Developed transportation makes large-scale commodity circulation possible, thus forming a commercial center. The location of modern architecture emphasizes the coexistence of traditional commercial formats and Western-style commercial formats, and emphasizes convenient transportation.

The traffic conditions in the Qing dynasty were walking, carriage and manpower shipping. In the modern times, steamships appeared, and docks and embankments were built on both sides of the Pearl River, greatly strengthening the exchanges and contacts between the two places. With the 1906 Canton-Hankow railway, the 1911 Kowloon-Canton Railway and the Dashatou Railway Station, The establishment of Yanjiang road airlines company, the terminal, the railway station, and the airlines have provided great transport convenience for the development of business activities, which promoted the large-scale exchange of personnel and logistics between urban and rural areas, and expanded the economic and cultural exchanges between cities. The construction of municipal projects such as postal telecommunications, roads, and running water has promoted the modernization of the city.

The road traffic system near the concession is not only conducive to the diversion and traffic of motor vehicles, but also creates more street frontages and friendly and pleasant street spaces. People can closely taste the city's commercial characteristics, the diversity of street interfaces and the richness of urban life. This development has greatly increased the overlapping and social opportunities of people's business activities. It is this extraordinary complexity and diversity of the road traffic network structure, as well as the flexibility and adaptability of the form, which promotes the development of the trade pattern, and is full of economic energy and vitality. The business district along Yanjiang Road is located in the most convenient area of the whole city traffic compared with Shangxiajiu Business District, and Beijing Road Business District, thus forming the most integrated business and trade area in the city.

#### *4.3 Impact of traditional trade culture on city business pattern*

In the late Qing Dynasty, Guangzhou handicraft industry is the most developed part in Guangdong Province. It is known as "Guangzhou Goods" and its products are sold in domestic and foreign markets, such as shipbuilding, casting and metallurgy, textile industry and arts and crafts. With the development of urban industry and commerce, and the competition and demonstration role of foreign firms, Guangzhou's urban financial industry has gradually transformed from traditional banks, pawn shops, money houses (old-style Chinese private bank), and remittances to modern banks and foreign firms. It has gradually formed a commercial space that satisfies the western business format. This kind of building forms a characteristic of the building's layout in the urban commercial structure with geographically convenient business dealings. For example, the distribution of modern customs buildings along the banks of the Pearl River, which continues the characteristics of the layout of the Guangdong Customs Supervision Department along the riverbank, is also a form of the layout suitable for the development of commercial and trade formats.

In modern times, with the expansion of Sino-foreign trade, the increase in the types of imported and exported goods, and the gradual disintegration of the natural economy around the city, traditional businesses began to transform into modern times. From the end of the 19th century to the first 20 years



of the 20th century, this transformation process was carried out with greater intensity and in a broader scope, highlighting the formation of urban business and service networks and the development of modern department stores. According to the statistics of the late Qing dynasty, and the early Republic of China, there were a total of 27,524 shops in Guangzhou City. These stores generally have a very fine professional division of labor, and gradually formed a professional distribution in the business street. During this period, Guangzhou also successively established some large-scale modern department stores, such as Zhenguang Company (founded in 1910), The Sincere & Co. Ltd. Company (founded in 1912), and Da Sun. Co . Ltd. Company (founded in 1918). In the financial industry, Guangzhou's old-style bank began to shift to modern financial institutions during this period, and its business scope and business methods have become increasingly modern. At the same time, the Chinese banks quickly emerged in Guangzhou. After the Revolution of 1911, the banking industry in Guangzhou developed even further with six banks, or branches, which have been established ten years after 1911.

The traditional business culture heritage space group has a certain influence on the connectivity of the modern space group. Since the Republic of China, the space group of the modern district has improved the integration of the space in the area, and the connection degree of the traditional commercial cultural heritage space group has also increased.

#### *4.4 Impact of population on city business pattern*

The quantity and intensity of the population directly affects the composition of consumption and actual consumption, and will inevitably promote the formation and development of commodity circulation hubs.

The distribution of population mainly includes two aspects. One is the distribution density of the population, and the other is the political and economic status of the population. Among the population of Guangzhou, half of people are merchants. Despite the wars of the dynasties that have been experienced, the commerce and trade industry in Guangzhou were still prosperous. With the rapid development of industry and commerce in the Nanguan area, along the Pearl River, and the Xiguan area outside the city in the Qing Dynasty, a large population of Guangzhou cities were gathered. According to the statistics of urban population in Guangzhou in the late Qing Dynasty, there were 517,596 people in the police area of Guangdong Province, of which 14,861 are in the old city and the new city, accounting for 28.71% (mainly concentrated in the east); the population of Henan on the South bank of the Pearl River is 67,586, accounting for 13.06%; 68,253 people in the Nanguan area, accounting for 13.19%; 23,314 people in the Xiguan area, accounting for 45.04%. According to the 1909 population data survey, Guangzhou has a population of about 600,000 and a total of 27,524 commercial shops in the city. Comparing the population data with the core density of commercial building, it can be seen that the higher the population density, the higher the core density of commercial building, and the more complex sociality.

## **5. Conclusion**

On the basis of the map of Guangzhou city blocks in 1948, this paper comprehensively uses the methods of GIS spatial analysis and historical literature analysis to partially restore the distribution and development of commercial buildings. Hereby, the core density of the distribution of commercial buildings in modern Guangzhou, and its influencing factors, were compared and analyzed. The main influencing factors of the distribution of modern commercial buildings in Guangzhou were the four major points of rivers, transportation, traditional trade patterns and population distribution.

In the "Warnings in Prosperous times", the modern businessman Zheng Guanying said, "There is no better way than boosting business to subdue foreigners for self-improvement" to emphasize the important influence of "business" in society and the country. Western-style commerce has become a new center of urban commerce and is trending to integrate with traditional commerce and trade.

The modern commercial buildings and block spaces in Guangzhou were formed and developed under the drive of commerce, which not only changed the impression of the city, but also stimulated

the construction and development of surrounding building, which finally led to the evolution of urban spaces. Using GIS technology to comprehensively consider the development of various types of buildings in the city, consider the interrelationship between various buildings, and interpret the social and cultural significance behind the various building forms of the city, which has important practical significance for understanding the formation and development of urban forms.

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