

Research on the Connection of Guangzhou Air and Railway under the Background of Guangdong-Hong Kong-Macau Greater Bay Area's Construction

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Abstract. In recent years, the construction of Guangdong-Hong Kong-Macao Great Bay Area has been in full swing. The development of Guangzhou airport economy has maintained a good momentum, and the construction of international aviation hub has accelerated. Meanwhile, Guangzhou railway hub has prominent location advantages, and the railway transportation network has gradually improved. How to improve the service of Guangzhou air-rail integration transport is directly related to the development of a comprehensive transportation system in Guangzhou. Through the demonstration of the conditions for the development of "air-rail integration transport" in Guangzhou, some shortcomings in "air-rail integration transport" have been analyzed. For example, there are relatively few metro lines for integration, and the railway hub has not yet been established. Some suggestions have been put forward to promote the construction of air-rail facilities, break down the barriers of air-rail sector, and improve the surrounding urban traffic.

Keywords: Guangzhou; Airport economy; Air-rail integration; Shortcoming; Suggestion.

In recent years, with the construction of Guangdong-Hong Kong-Macao Greater Bay Area and transportation infrastructures, the connection between cities have become closer. Since Guangzhou located in the center of Guangdong-Hong Kong-Macao Greater Bay Area, Guangzhou, as the center of Guangdong-Hong Kong-Macao Greater Bay Area, is building an international aviation hub, an international shipping hub and an international innovation hub. In addition, the development of Guangzhou airport economy has maintained a good momentum, and the construction of international aviation hub has accelerated. Meanwhile, Guangzhou railway hub has prominent location advantages, and the railway transportation network has gradually improved. Promoting the connection of Guangzhou air-rail integration is conducive to improving the comprehensive transportation system of Guangdong-Hong Kong-Macao Greater Bay Area, strengthening its radiation to surrounding cities, realizing the interconnection of Guangdong-Hong Kong-Macao Greater Bay Area and playing an important role.

1. Condition Analysis of the Establishment of Mechanism of Air-Rail Integration in Guangzhou

1.1 Basic Conditions of Air Transport

Currently, the grade index of flight area of Guangzhou Baiyun Airport is 4F. Three runways in the airport have been put into operation. In April 2018, with the opening of terminal T2, Guangzhou Baiyun Airport can meet the demand of 620,000 flights, 80 million passengers and 2.5 million tons cargo and mails. As of October 2018, Guangzhou Baiyun Airport has more than 300 air lines. The airlines have covered more than 220 destinations around the world, including 86 international and regional destinations, reaching more than 50 countries and regions of Europe, America, Oceania, Africa and Asia. In addition, Qatar Airways, Air France, Aeroflot-Russian Airlines, China Eastern Airlines and other 78 Chinese and foreign airlines have settled here, among which China Southern

Airlines, 9 Air Airlines and Longhao Airlines have their main operation bases or headquarters in Guangzhou Baiyun Airport. [1]

1.2 Basic Conditions of Railway Transportation

At present, Guangzhou has opened the Beijing-Guangzhou, Guiyang-Guangzhou, Nanning-Guangzhou, Guangzhou-Zhanjiang, Guangzhou-Shenzhen-Hong Kong and other high-speed rails as well as Guangzhou-Shenzhen, Guangzhou-Foshan-Zhaoqing, Guangzhou-Zhuhai City Rails. General rails can access to the country's major cities. Guangzhoubei Railway Station near Baiyun Airport has introduced Beijing-Guangzhou General Railway, Beijing-Guangzhou High-speed Railway, subway line 9, and reserved lines such as Guangzhou-Heyuan, Guangzhou-Zhanjiang, Guangzhou-Yongzhou, Guizhou-Guangzhou Special Passenger Lines and northeast bus lines.[2] In addition, three intercity railways, namely Guangzhou-Qingyuan Railway, Guangzhou-Foshan Loop Line Railway and Guangzhou-Dongguan-Shenzhen Railway, are under construction and will be completed in 2022. Guangzhoubei Railway Station will become a comprehensive transportation hub in Asia-Pacific region by integrating high-speed railways, general railways, urban rails and subways with 37 lines and 18 platforms. The daily passenger volume of the station will reach 140,000. Datian, Dalang Railway Freight Stations and Jiangcun Marshalling Station are only about 20 km away from Baiyun Airport. Datian Railway Freight Station will be transformed into container center station of Guangzhou Railway, and its freight volume is expected to exceed 20 million tons per year in 2030. Dailang railway freight station has opened Sino-Europe Railway, South Asia Railway and Vietnam Railway. By the end of 2017, Guangzhou metro had opened a total mileage of 390.6 km, ranking the third in China. Among them, the Airport South Station of metro line 3 and the Airport North Station seamlessly connected with the terminal T1 and T2 of Baiyun Airport respectively.

1.3 Economic and Social Conditions

Guangzhou is located in the center of Guangdong-Hong Kong-Macao Greater Bay Area. The resident population of the area is nearly 70 million, accounting for 1/20 of the total population in China. The total GDP of this area accounts for about 1/8 of the country's total, and the per capita GDP reaches 21,750 USD. The total import and export volume of the area exceeded \$2028.2 billion, accounting for about 2/5 of the total import and export volume of China (including Hong Kong and Macao), and one-third of the trade volume with ASEAN [3]. Guangzhou is the economic, political and cultural center of Guangdong Province. Guangdong's population density is 4.29 times the national average, with more than half concentrated in the Pearl River Delta region. Guangzhou also gathered BeiGene, Xiangxue Pharmaceutical, Guangzhou Pharmaceuticals Corporation, Da An Gene, Wondfo, CMS, Darui Biological and other well-known bio-pharmaceutical enterprises. Guangzhou bio-pharmaceutical industry scale can reach 500 billion yuan in the near future, and the scales will exceed trillion yuan in 2025. In addition, Foxconn, Cisco and China Electronics Corporation have invested and set up factories in Guangzhou. Hence, the output value of electronic information manufacturing industry in Guangzhou will reach 400 billion yuan in 2020. Among them, South China Electronic Information Industrial Park is located in Xinhe Street between Baiyun Airport and Guangzhoubei Railway Station, creating a hundred-billion-level intelligent electronics industry cluster. The volume and value of the goods of cross-border e-commerce in Guangzhou ranked first in China for four consecutive years. Large population, dense population, high level of economic development, active foreign trade and the development of biomedicine, electronic information, cross-border e-commerce and other industries will provide strong support for the social needs of mechanism of air-rail Integration in Guangzhou.

2. Shortcomings in the Connection of Mechanism of Air-Rail Integration in Guangzhou.

2.1 The Metro Lines for Intermodal Transportation are Insufficient, and the Transportation Capacity Needs to be Improved

At present, only Guangzhou metro line 3 and line 9 run through Guangzhou Airport Economic Zone. Guangzhou Baiyun Airport has only two metro stations, Airport South Station and Airport North Station. Since the opening of Guangzhou metro line 9 at the end of 2017, Guangzhou metro line 3 has become more crowded, with the average monthly passenger flow exceeding 2 million. Generally, the traffic diversion of metros, light rails and other rail traffic accounts for more than 50% of the total diversion of the airport, while the north extension of Guangzhou metro line 3 is the only way to diverge airport traffic. In 2017, the passenger throughput of Guangzhou Baiyun International Airport was 65.837 million, and the airport only connected by Guangzhou metro line 3. Shanghai Hongqiao Airport, however, handles 41,884 passengers, but the airport is connected by three metro lines [4]. Compared with Shanghai Hongqiao Airport, the metro transportation capacity of Guangzhou Baiyun Airport is obviously backward. Hence, the transportation capacity of the metros of Guangzhou Baiyun Airport needs to be further improved.

2.2 The Railway Hub has not been Established and Air-Rail Integration is not Close Enough

The nearest railway station to Baiyun Airport is Guangzhoubei Railway Station. At present, hub of railway transportation of Guangzhoubei Railway Station is under construction. The hub is about 30 km away from the downtown, with a total construction area of only 23,000 square meters and 6 waiting rooms. The total number of stops is 45 per day, which is a second-class railway station. [5] Neither the facilities of the station platform and building area nor the parking number meets the requirements of large railway hubs. The railway freight stations near Guangzhou Baiyun Airport are Datian and Dalang Railway Freight Stations with lower grade. The stations are all in the process of reconstruction and construction, and the capacity of cargo turnover has not been fully achieved. At present, there is no direct metro from Guangzhou Baiyun Airport to Guangzhoubei station. Therefore, passengers need to transfer to metro line 9 at Gaozeng station via metro line 3. The departure interval of metro line 9 is up to 6 minutes, and it takes about 40 minutes to transfer from Guangzhou Baiyun Airport to Guangzhoubei station. There is no direct route from Guangzhou Baiyun Airport to Datian and Dalang Railway Freight Stations. Therefore goods need to be transferred by road transportation, which will lead to low efficiency of cargo transportation and high loss rate of cargo.

2.3 The Management System is Segmented and Different Departments Operate Independently

Because air-rail integration involves two different transport departments, different transport departments have different management systems. For example, Guangzhoubei Railway Station and Datian Railway Freight Station are under the supervision of Guangzhou Railway Group, while Baiyun Airport is under the supervision of Guangdong Airport Authority. The Railway Transportation Department and Civil Aviation Ministry are not in a same system, and it is difficult to ensure the unity of objectives in the implementation of specific tasks [6]. There is no specific connection line between Guangzhou Baiyun Airport and Guangzhoubei Railway Station. The direct distance between the airport and the railway station is obviously closer than the airport to Guangzhoudong Railway Station, but the time for the airport to go to Guangzhoudong Railway Station railway station is shorter than the airport to Guangzhoubei Railway Station. If a special railway line from Guangzhoubei Railway Station to Baiyun Airport was planned to be built now, it is necessary to communicate with Huadu District Government, Baiyun District Government, Guangzhou Railway Group, Guangzhou Baiyun Airport and other departments and units. The existing part of land and buildings in Guangzhou Airport Economic Zone belong to Baiyun Airport and Southern Airlines. When planning the construction of international aviation hub, it is necessary to coordinate with two provincial state-owned enterprises. If Guangzhou Airport Economic Zone

wants to establish the mechanism of air-rail integration, the transportation hubs, Baiyun Airport and Guangzhoubei Railway Station need to be unified planning.

2.4 Single Air and Rail Transport Mode and Poor Traffic in Surrounding Cities

At present, there is only one way in air-rail integration of Baiyun Airport. The realization of air-rail integration only by metro and airport will lead to impeded and inconvenient transport for passenger and cargo. The mode of air-rail integration is too single. Baiyun Airport is far less than Shanghai Hongqiao Airport, which has four modes of air-rail Integration, namely high-speed rail, general rail, urban rail and metro, and Pudong Airport, which has two modes of air-rail Integration, namely metro and maglev. Guangzhou Baiyun Airport has no direct air and rail lines to surrounding areas such as Qingyuan, Shaoguan, Huizhou, Zhongshan and other cities. Even from Foshan, the most closely connected city in the region, people are required to have more than two transfers to reach Guangzhou Baiyun Airport. From Zumiao Station of Foshan City Metro, it takes 4 times to transfer to Guangzhou Baiyun Airport by metro, and the transit time is 110 minutes. In addition, it takes more than 2 hours from Yifeng International Airport in the west district of Zhongshan city to Baiyun International Airport by light rail and metro, and about 3 hours by road transfer. From Songshan Lake, Dongguan, it takes about 2 hours to get to Guangzhoubei station via Humen Railway Station. And then it is necessary to transfer to Guangzhou metro line 9 and line 3. However, it only takes about 40 minutes to get to Shenzhen Baoan Airport from Songshan Lake, Dongguan.

2.5 Limited Efforts in Product Development and the Lack of Standards and Specifications of Air-Rail Integration

In 2012, China Eastern Airlines and Shanghai Railway Bureau jointly launched a product called "Kong Tie Tong", realizing quick transit of air and rail transportation. At present, in Shanghai Hongqiao Airport, Pudong Airport, a total of 300 flight products were launched between Shanghai and major Yangtze River Delta cities such as Nanjing, Hangzhou, Suzhou and Ningbo. In addition, Hainan Airlines will offer second-class tickets of the high-speed train from Meilan Airport to Sanya for the passengers flying on Hainan airlines. Meanwhile, China Southern Airlines only carries out air-rail integration on the cities in Beijing-Guangzhou high-speed railway for the passengers who arrive from Guangzhou Baiyun Airport to other cities. But these are not exactly an "air-rail integration", because air transportation and railway transportation belong to different transportation systems. Hence, the ticketing codes are not unified, and the ticketing system information is not compatible. The consequence is that there is a lack of delivery of luggage consignments between air and rail transportation in different places. Therefore, the air and rail transport system with the true sense of "one ticket to the end" has not been established.

3. Measures and Suggestions for Improvement of the Air-Rail Integration Transport in Guangzhou

3.1 Planning New Metro Lines to Enhance Evacuation Capability of the Airport

This plan takes Baiyun Airport as the center and plans to build 7 new metros step by step according to a cycle of 3 years, so as to form a double-cross-shaped metro network pattern, which greatly improves the distribution capacity of Baiyun Airport and enhances the radiation range of Baiyun Airport. Planning for the new APM fast transfer line from Guangzhoubei Station to Baiyun Airport will shorten the transfer time from Guangzhoubei Station to Baiyun Airport to less than 10 minutes. The second phase of Guangzhou Metro Line 18 is planned to extend from Wanqingsha Station to Zhongshan City via Minzhong Town to the South and from Guangzhoudong Station to Qingyuan City via Baiyun Airport to the north, so as to further enhance transport capacity of Baiyun Airport to Zhongshan and Qingyuan. The second phase of Guangzhou Metro Line 9 is planned to run through Zhongluotan Town to Sino-Singapore Guangzhou Knowledge City from Gaozeng Station. The new line from Baiyun Airport to Qingtang to Xiameao to Tangxi to Guangzhou Railway Station Metro

can shorten the distance between Baiyun Airport and Tangxi Railway Station and between Baiyun Airport and Guangzhou Railway Station. Another new line was planned from Baiyun Airport to Bamboo Material to high-speed metro of Sino-Singapore Guangzhou Knowledge City, which was designed for speed of 200 km/h. The new line will strengthen the international aviation hub and transportation links of International Innovation Hub. The new line from Baiyun Airport to Jianggao Town to Foshan Sanshui High-Speed Metro can provide convenient services for residents in northern Foshan by air.

3.2 Promoting the Construction of Air and Rail Facilities and Strengthening the Functions of Railway Hubs

The construction of land acquisition, demolition and housing resettlement of Guangzhoubei Railway Station should be sped up, and Guangzhoubei Railway Station should be built into a comprehensive transportation hub integrating ordinary railways, high-speed rails, urban rails and metros. The construction of Guangzhou-Qingyuan, Xinbaiguang, Guangzhou-Foshan Intercity Railway and the northeast outer route for trucks of Guangzhou railway hub is supposed to be promoted. The second phase of the northern extension of Guangzhou Metro Line 8, Guangzhou-Heyuan High-speed Railway, Guangzhou-Zhanjiang High-speed Railway and Guangzhou-Qingyuan-Huaihua High-speed Railway can be planned to build. Northeasten contact line of coaches should be set up to connect Guangzhoubei Railway Station with Guangzhou Railway Station, and Tangxi Railway Station can be upgraded. Beijing-Guangzhou high-speed railway should be introduced and be built into a comprehensive transportation hub, integrating ordinary railways, high-speed railways, metros and buses. Guangzhou Railway Station was upgraded in situ. The area of stations and waiting rooms was increased, and bullet train stations were added. The scale of platform was expanded from 4 stations and 7 lines to 11 stations and 22 lines. TOD, an urban comprehensive hub, can be built in Guangzhoudong Railway Station. Construction progress of metro line 11, metro line 18, Guangzhou-Shantou High-speed Railway and Guangzhou-Dongguan-Shenzhen Intercity Railway can be accelerated. Beijing-Kowloon passenger dedicated line can be introduced, and the capacity to platform 10 line 20 can be expanded. Datian Railway Freight Station will be transformed according to the standard of first-class railway freight station to become a nationally renowned railway container freight center. The Dalang Railway Freight Station will be transformed according to the standard of second-class railway freight station, and the international trains from Guangzhou to Europe, Central Asia, Southeast Asia, South Asia and other countries or regions will be added.

3.3 Government Uniformly Plan and Coordinate to Break the Barriers Between Air and Rail Sectors

The Guangdong provincial government shall contact the Central and Southern Regional Administration and Guangzhou Railway Group, and coordinate Guangzhou Baiyun Airport, airlines, Guangzhou Railway System and Guangzhou Municipal Government, to sign the strategic cooperation agreement of the planning of Guangzhou air-rail integration, and to make a unified plan for Guangzhou aviation hub, Guangzhou railway hub and transport line of air-rail integration. Combined with railway hub Layout Schemes of Guangzhou (2016-2030), "Guangzhou City Master Plan (2017-2035)", the Third Phase of The Construction of Guangzhou Urban Rail Transit Planning (2017-2023), the 13th Five-Year Plan of Land Use of Guangzhou (2016-2020), Guangzhou should establish development plan of air-rail Integration, promote efficient customs clearance, inspection and "Zero Distance" connection between air and rail, which help realize the interconnection of waiting stations, takeover of the goods between air and rail, and delivery through combined transport. At present Baiyun Airport terminal T4 is set up at Guangzhoubei Railway Station. Hence, passengers can wait for the flight immediately after they get off the train at Guangzhoubei Railway Station. [7] Breaking the barriers of air and rail departments, establishing the information system of air and rail stewards and promoting the information sharing of air and rail intermodal transport, Guangzhou Railway Group and Southern Airlines pilot unified the ticketing system and set air-rail integration tickets. Air-rail departments can act as agents for each other to sell tickets. In addition, "One Ticket to the End"

for passengers and luggage goods can be achieved, which brings convenient services for passengers. [8]

3.4 Provide Multiple Transport Services and Improve Traffic in Surrounding Cities

Drawing on the air and rail transport modes of Tokyo Narita Airport in Japan, Shanghai Hongqiao Airport and Changsha Huanghua Airport, Guangzhou Baiyun Airport should provide tram, general rail, high-speed rail, maglev and other air and rail transport services to improve the traffic environment of Qingyuan, Foshan, Zhongshan, Dongguan, Huizhou and other cities around Guangzhou. A high-speed railway station will be set up in terminal 3 of Baiyun Airport to further reduce the transfer time and frequency of air and rail intermodal transport. It is also planned to build a new maglev line from Zhongluotan Town to Baiyun Airport to Huadu Lake Park to Yayao Town and the line from Baiyun Airport to Huashan Town to Timian town to Qingyuan city to improve the transportation efficiency from north Guangzhou and north Guangdong to Baiyun Airport. The high-speed line from new established Baiyun Airport to Jianggao town to Lishui town to Shishan town to Foshanxi Railway Station promote the integration of Guangzhou-Foshan transportation. The planned construction of the new high-speed railway from Guangzhou to Qinghai to Huaihe will greatly shorten the distance between the mountainous areas in northern Guangdong, the southern areas of western Hunan, even the Chongqing and Guizhou and Guangzhou. It is planned to build a new passenger line from Guangzhoubei Railway Station to Baiyun Airport to Conghua to the Second Airport to Yonghan to Heyuan to strengthen the influence of Baiyun Airport on Conghua, Zengcheng, northeast Guangdong and southwest Fujian. A high-speed rail link between Baiyun Airport and Guangzhoudong railway station will be established to accelerate the construction progress of high-speed railway between Guangzhou to Shantou and shorten the travel time from Huizhou, Shantou, Shanwei and other areas in eastern Guangdong to Baiyun Airport. The new high-speed railway from Guangzhou to Zhanjiang is planned to bring the Baiyun Airport closer to Jiangmen, Yunfu, Yangjiang, Maoming, Zhanjiang and other coastal cities in western Guangdong.

3.5 Innovate Air and Rail Integration Products and Establish Standards of Transport

Innovative products such as "Aviation plus High-speed Rail", "Aviation plus General Rail", "Aviation plus Urban Rail", "Aviation plus Metro", "Aviation plus Maglev" and "Flight plus Train" have been launched to further promote the services of air and rail transport in the Guangdong-Hong Kong-Macao Greater Bay Area. [9] In addition, "Air plus High-speed rail" and "Virtual" Flights have been launched, and "Guangdong-Hong kong-Macao link" has been implemented. In the cooperation with Baiyun Airport and the airlines in the Guangdong-Hong Kong-Macao Greater Bay Area and major high-speed rail stations in Guangdong Province, the combination ticket price of high-speed rail ticket plus air ticket is lower than that of high-speed rail plus air section ticket price. The passenger who have combination ticket even have priority to change and transfer. "Aviation plus Urban Rail", via bus operation of urban rail of Baiyun Airport, run every 3 minutes with fast and slow lines. The "Air plus Metro" product allows passengers to enter and exit the metro station by swiping their ticket after security check. They can take the metro once for free in Guangzhou, which can save their time of entering and exiting the metro station. The metro passage fee is shared by the airline and the metro company. The passengers who have "Air plus Maglev" can enjoy a 20% discount ticket with tickets to ride the maglev trains. They only need to swipe ticket to go in and out of the ticket gates of maglev station. "Flight plus Train" opens up regular air freight lines, aimed at the larger shipping points that have stable air freight volumes. In order to improve the efficiency of air-rail integration transport of goods, the product also links up with the 'Five Scheduled' Train set up by the railway department. Baiyun Airport and Guangzhou Railway Departments jointly formulate media advertisements and publicize each other to provide guidelines of transport transfer for air-rail integration transport. They also formulate standards for air-rail integration service, carry out pilot work of air-rail integration transport, regularly train staff of air-rail integration transport, and popularize and apply good service experience.

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