Brief Analysis on the Design Points of the Site Selection for the Relocation of Airports in the Branch Line—— Taking the Relocation of Nanyang Airport as an Example

Su Ruifang*, Sun Rui

1 Airport Planning and Design Institute, China Aviation International Construction and Investment Co., Ltd., Beijing, 100120, China

*Corresponding author’s e-mail: 120327981@163.com

Abstract. With the continuous enhancement of state support, China's civil aviation has ushered in an unprecedented period of development. At the same time, along with the continuous expansion of urban construction land and the large number of new urban infrastructure building, the existing land use of regional airports in some small and medium-sized cities in China has contradicted the urban development direction and non-airport infrastructure construction. The more cities began to relocate the existing regional airports. Taking the Nanyang Airport relocation project as an example, this paper starts from the four aspects which are civil aviation status and development constraints, the influencing factors and necessity analysis of airport relocation, civil aviation development prospects and scale prediction, and the factors affecting the site selection of airport relocation. Based on the above analysis, we propose the basic framework, research methods and implementation strategies for the location of the relocation of the regional airport, which are expected to provide a reference for the relocation of other regional airports.

1. Introduction

The feeder airport is an important link to improve the airport network and form the network layout of the hub, trunk and feeder airports. It is also an important node for further improving the comprehensive transportation system [1]. In recent years, the annual passenger throughput and peak hours of civil aviation have increased significantly year by year. China's regional airport construction has ushered in an unprecedented development period. However, along with the continuous improvement of urbanization level, the continuous expansion of urban construction land, and the large-scale construction of important infrastructures such as urban high-speed railway stations, the location and scale of the existing feeder airports in some domestic small and medium-sized cities have contradicted the urban development direction and the construction of infrastructure such as the new high-speed railway station[2-4]. For this reason, more and more cities in China have begun to relocate the existing regional airport to adapt to the development of the city and the growing demand for air travellers in the new period.

2. Civil aviation status and development constraints

Nanyang Airport is located 1,000 meters east of the downtown area of Nanyang City. It is adjacent to National Highway 312 and Shanghai-Shaanxi Expressway. It has convenient transportation conditions and provides air services for Nanyang City and its surrounding areas. The airport was built in October
1992 and covers an area of 2,903 mus. The flight area index is 4D. The runway is 2,800 meters long and 45 meters wide. It can meet the take-off and landing of large and medium-sized aircraft such as Boeing 737, Boeing 757 and Airbus A330. The airport terminal was expanded in November 2008 and delivered in 2010. The design target year is 2015, which can meet the peak passenger hours of 531 passengers and the annual passenger throughput of 570,000 passengers. The size of plane parking apron is 534×130m, it includes a total of 10 aircraft positions. Among them, the 1st to 9th aircraft position is Class C, and the 10th aircraft position is Class D. The size of universal plane parking apron is 328×45m, it can accommodate 7 B-class aircraft positions.

The problems in the constraints of airport development are as follows:

- The current location of the airport and the urban development are mutually constrained. The airport is too close to the city to have problems with the city's long-term development plan. The direction of urban development is southward and eastward, while Nanyang Airport is on the southeast side of the city, where has played a controlling and restricting factor on the height, density and clearance of surrounding buildings. With the rapid development of economy in Nanyang, the scope of urban construction land will surely cross the White River and become closer to the airport area. In fact, the development of Nanyang Airport and the entire city of Nanyang has already had mutual constraints and restrictions. The Nanyang Airport flight area has no possibility of expansion.

- The current location of the airport and environmental are mutually constrained. At present, Nanyang Jiangying Airport has three areas of north, west and south, which are gradually approached and surrounded by urban residences, industrial areas, municipal facilities and roads. If Nanyang Airport is planned to further expand airport capacity and increase passenger throughput, it will inevitably generate more and louder noise, which will cause interference to surrounding residents. This is a relatively direct and realistic constraint to the development of Nanyang Airport, and it is also a hidden danger in the stable development of society.

3. Civil aviation development prospects and scale prediction

According to the analysis of the current situation of economic and social development in Nanyang City, we identify the index factors that have a greater impact on the growth of airport traffic. Further, this paper studies the relationship between changes in various indicators and changes in airport traffic. At the same time, we use the economic correlation method and the tourism related method to predict the passenger throughput of the airport. According to the forecast of aviation traffic volume, by 2017, the passenger throughput of Nanyang City was 786,600 person-times. It is ranked 95th in the country. The overall cargo and mail throughput showed a clear upward trend, and the annual growth rate is above 11.92%. The cargo and mail throughput in 2017 reached 962.4 tons with ranking 117th in the country and having an increase of 6 places over 2016. By 2030, the passenger throughput will reach 4 million passengers per year, while the take-off and landing sorties will be 34,782 per year. According to the forecast, the terminal area is 35600 square meters and the parking lot is 32700 square meters. In addition, the number of apron aircraft is estimated to be 18. Passenger throughput will reach 9.5 million passengers per year by 2050, and the take-off and landing sorties will be 82,481 per year. It is predicted that the long-term terminal building is 98300 square meters, and the parking lot is 63900 square meters. At the same time, the number of apron aircraft is estimated to be 41.
### Table 1. Summary of aviation business volume forecast.

| Category                                  | Type      | 2025 (Year) | 2030 (Year) | 2050 (Year) |
|-------------------------------------------|-----------|-------------|-------------|-------------|
| Annual passenger throughput (ten thousand people) | Domestic  | 233         | 378         | 760         |
|                                           | International | 12          | 42          | 190         |
|                                           | Total      | 245         | 420         | 950         |
| Annual aircraft movement (flights)         | Domestic   | 20416       | 32869       | 65517       |
|                                           | International | 1166       | 3750       | 16964       |
|                                           | Total      | 21582       | 36619       | 82481       |
| Passenger planes take off and land during peak hours (flights) | Domestic  | 12          | 16          | 28          |
|                                           | International | 1           | 3           | 10          |
|                                           | Total      | 13          | 19          | 38          |
| Peak hour passenger numbers (people)       | Domestic   | 1160        | 1682        | 3497        |
|                                           | International | 200        | 279        | 1014        |
|                                           | Total      | 1360        | 1961        | 4511        |
| Reservation number                         | Domestic   | 13          | 17          | 30          |
|                                           | International | 1           | 3           | 11          |
|                                           | Total      | 14          | 20          | 41          |
| Class B aircraft                           |            | 1           | 1           |             |
| Class C aircraft                           |            | 13          | 19          |             |

#### 4. Analysis of Airport Relocation Sites

According to the relevant specifications of civil airports, the main factors for the relocation of Nanyang Airport are as follows:

- The clearance, airspace and meteorological conditions of the airport site can meet the requirements for safe operation of the airport.
- The distance between the site and the central city is moderate, and the airport operation and development are coordinated with the urban long-term development plan.
- The venue area can meet the needs of the current construction and long-term development of the airport.
- The site should have construction conditions for facilities and systems such as aviation fuel, power supply, water supply, gas supply, communication, roads, and drainage.
- The site should conform to the land use plan and try not to occupy good land, cultivated land, woodland, wetland or grassland. In addition, the demolition volume of residents is reduced as much as possible.
- The site should meet the requirements of ecology, environmental protection and cultural relics protection, and there is no important mineral deposit in the underground area.
- The project investment should be economical and reasonable.

4.1. Runway direction
After relevant analysis, the direction of the new airport runway is tentatively set southwest-northeast, which is parallel to the existing runway direction of Nanyang Airport.

4.2. Analysis of Airport Service Objects
The main service target of the relocated Nanyang Airport is the citizens of Nanyang downtown. At the same time, the planning scope of Nanyang New City will be considered. Refer to the “Civil Aviation Regional Airport Construction Standard” (MH5023-2006), the regional airport site should be close to the urban area, and it should be about 1,000-1,500 meters from the planned edge of the urban area. For convenience, we draw the radius of 2,000 meters and 2,500 meters from the downtown area of the city. The range is 1,000 to 1,500 meters from the edge of urban planning. Airport location will be carried out within this range.

4.3. Analysis of airspace conditions
From the relationship between Nanyang Airport and the surrounding airports, there are 5 airports within a radius of 150,000 meters. Among them, the distance between the nearest airport and Nanyang Airport is 68km, and the distance between the farthest airport and Nanyang Airport is 145km. Judging from the airport construction experience, the two airports are more than 100,000 meters apart and usually do not cause interference. However, if the two airports are within 100,000 meters of each other, the comprehensive factors of airport orientation and route need to be considered for analysis.

4.4. Relations with neighboring airports
Judging from the macroscopic concept of the adjacent area, it can be roughly judged that Nanyang Airport has little effect on the take-off and landing of the surrounding military and civil aviation airports. However, if a new airport is considered in the Nanyang area, the airspace used by the airport must not overlap with the adjacent area of the surrounding airport or its airspace.

4.5. Relationship with surrounding air routes
From the perspective of the surrounding restricted airspace distribution, Nanyang Airport is 111km away from the ZH (R) restricted area above. This distance is far from the airport. If a new airport is built in the Nanyang area, the airport should be located away from the restricted area and the training airspace of the military airport.

4.6. Analysis of topography and topography around the city
As far as the terrain around the downtown area of Nanyang city is concerned, the east side of the city is flat and open, which can be used as an airport location area. The terrain on the west side is undulating, and there are many gullies and slopes. But if we level the ground, it can meet the applicable requirements of the airport and can also be used as an alternative area for the site. However, it is necessary to avoid individual high mountains to meet the requirements of airport clearance.

4.7. Restriction Analysis of Urban Master Plan
In the “Nanyang City Master Plan”, the land within the planned area is divided into three areas, which are banned construction areas, restricted areas, and suitable construction areas. At the same time, different space control strategies were determined according to different partitions. According to the
land plan of Nanyang City, the location of the airport should be avoided in the restricted area. This version of the Nanyang City Master Plan is about to be revised. Therefore, after the location of the airport relocation is determined, it is necessary to reserve sufficient construction land in the new version of the Nanyang City Master Plan based on the land use situation.

4.8. Analysis of other restrictions

4.8.1. Analysis of the relationship between airport and city. In order to avoid flying and landing routes across the city, the location of the airport should be avoided in the northeast and southwest directions of the city. It is best to arrange the airport on the side of the city, so that the distance between the airport and the city can be appropriately reduced. At the same time, this will also reduce the investment in municipal supporting facilities, and also reduce the travel time and economic cost of passengers during later operations. Taking the above factors into consideration, the location of Nanyang New Airport should be selected in the east and west directions of Nanyang City.

4.8.2. Restriction analysis of high-voltage corridors. According to the relevant regulations of the Civil Airport Master Plan (MH5002-1999), the distance between the high-voltage overhead transmission line of 110kV above and the runway end or the runway center line shall not be less than 4km. In addition, the distance between the high-voltage power line and the glide path of the aircraft shall not be less than 300m. For this reason, when determining the location of the Nanyang New Airport, it should try to avoid the high-voltage line. When the current situation of land use is insufficient, it is necessary to maintain a minimum safety distance from the high-voltage lines.

Based on the above analysis and investigation of the current situation of Nanyang City, the main directions for the site selection of this new airport are the northwest and southeast directions of Nanyang City. The range of the airport site can be within 20 to 25 kilometers from the city centre, or it can be appropriately larger as required. If the site is located in the northwest of the city, it is necessary to avoid the hills with higher elevations or to clean the hills. If the site is selected in the southeast direction, it can satisfy the traffic layout of Nanyang City to build a comprehensive development of high-speed rail and airport. It is the preferred area. Avoid high-level high-voltage lines when selecting a site. Because the rural area of Nanyang is very densely distributed, the demolition volume should be minimized when selecting the site.

5. Conclusion

The relocation of the regional airport should not only be selected from the conventional model, as well as having comprehensive consideration of specific issues such as city location conditions in order to choose the best site that meets the requirements of civil aviation transportation and regional economic development. In the previous discussion of the article, we explained the design points of the site selection by combining airspace and ground conditions. We recommend that airspace conditions and headroom conditions should be given priority in the next stage of work. This article provides guidance and reference for the selection of other regional airports in China to further promote the development of civil aviation.

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