Simulation Analysis of the Taxiing scheme of a Large International Airport Flight Area

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Keywords: Airport's configuration of multiple runways; taxi path planning; SIMMOD simulation; flight zone operation; the evaluation of operational plan.

Abstract: In-depth analysis and design of aircraft taxi paths for complex multi-run and multi-slide flight zone systems that China's large international airports will face; simulation design and simulation application analysis through simulation software SIMMOD Plus, and evaluation of output data The operating efficiency of the airport flight zone in different operating modes, providing recommendations for running capacity and flight schedule planning.

1. Background

The most closely related link in the airport to ensure the operation of the flight must be the guaranteed operation of the flight area. Whether the layout of each functional area and the planning of the taxi path directly affect the operational safety and efficiency of the airport. When the actual cost of building the airport is much higher than the simulation operation and it is difficult to achieve, The purpose of this study is to use the characteristics of repeatability and continuity of micro-simulation technology to simulate the flight path design scheme of the airport flight zone multi-run and multi-slide system in different flight seasons, and output the taxi time, Delay and other indicators. Quantitative data is used to analyze the operation of aircraft in the flight zone, and finally a reasonable flight zone taxiing plan and reasonable use of seats are formed to achieve the goal of a good air transport structure at the airport.

2. Cogitation of the Research

Taking the multi-running, multi-sliding flight area design plan of a large international airport as the starting point, referring to the optimization rules, methods, methods and relevant rules and principles of the taxi path, and combining the predicted operational data to design the taxi path of the selected airport taxi system.

Understand and collect the infrastructure conditions that the airport should have, and formulate corresponding runway usage methods and operating modes and taxi paths according to the characteristics of the airport runway. Based on the SIMMOD Plus simulation software platform, a reasonable simulation model is constructed according to the large international airport studied, and a reasonable aircraft taxi path plan is developed for simulation operation.

3. Research Program

3.1 Collection of basic data of aircraft in the flight zone.

The current status of the research target airport is 25 million passengers per year, and the target annual designed throughput is 80 million passengers. The estimated daily flight volume is 1530 flights, and a sample flight plan for simulation is assumed.

In the design plan, there are 4 parallel runways in the runway. The first runway (3200 m × 45 m, E) and the second runway (3800 m × 60 m, F) are shown in the figure. On the basis of the runway, the third runway (3600m × 45m, E) and the fourth runway (3600m × 45m, E) are added to meet the needs of aircraft take-off and landing operations and rapid departure from the runway. Show in Figure 2 below.

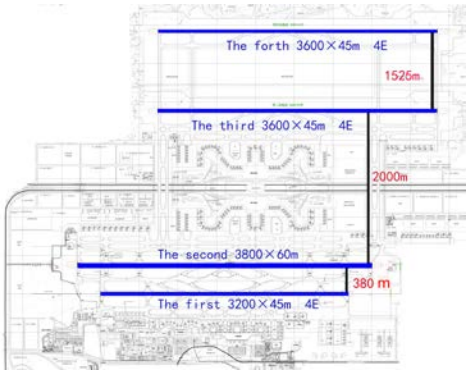

Fig. 2 Runway configuration of the airport in the coming year

The first and the second runways are close-range parallel runways, and their operation mode is isolated parallel operation; the third and fourth runway centerline intervals are in accordance with the mode of independent take-off and landing, which are the take-off and run-off runways and the landing runway respectively .Figures 3 and 4 are schematic diagrams of the main takeoff and landing and secondary takeoff and landing directions of the runway designed for this large international airport in the coming year.

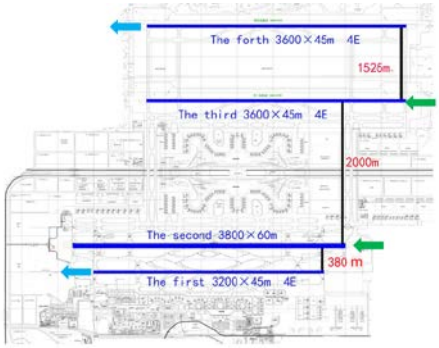

Fig. 3 Runway main takeoff and landing (northbound)

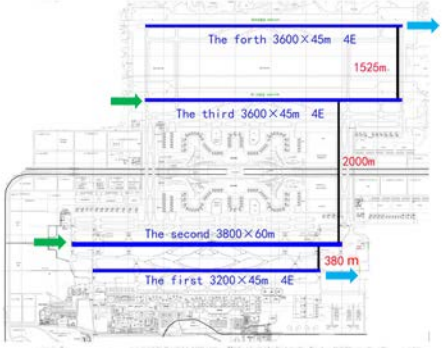

Fig. 4 Runway takeoff and landing (southbound)

4. Operation mode and scheme design.

The operation mode of aircraft using runways at the airport is divided into two directions: north and south. It is determined by the monsoon climate of the airport's geographical location. Figure5 shows the planned path for the aircraft to taxi north to the main takeoff and landing direction.

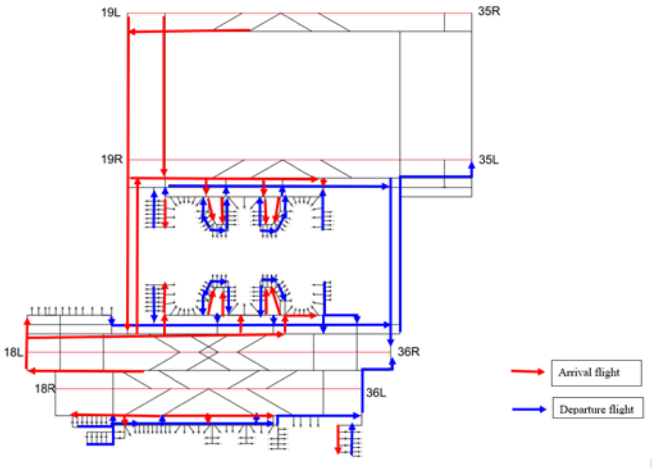

Fig. 5 Plane taxi path plan of a large international airport in the coming year

5. Results

SIMOOD is used to build and study the aircraft simulation model platform for large international airport flight area. Random simulation seeds are used to conduct a 24-hour simulation of aircraft operating conditions in the large international airport flight area.

The analysis of the output data of the northward main take-off and landing scheme simulation operation model shows that the statistics of departures and taxi times of departure flights throughout the day and the average delay time of ground taxis are shown in Figures 6,Figures7 show the statistics of flight times and taxi times and the average flight delay time.

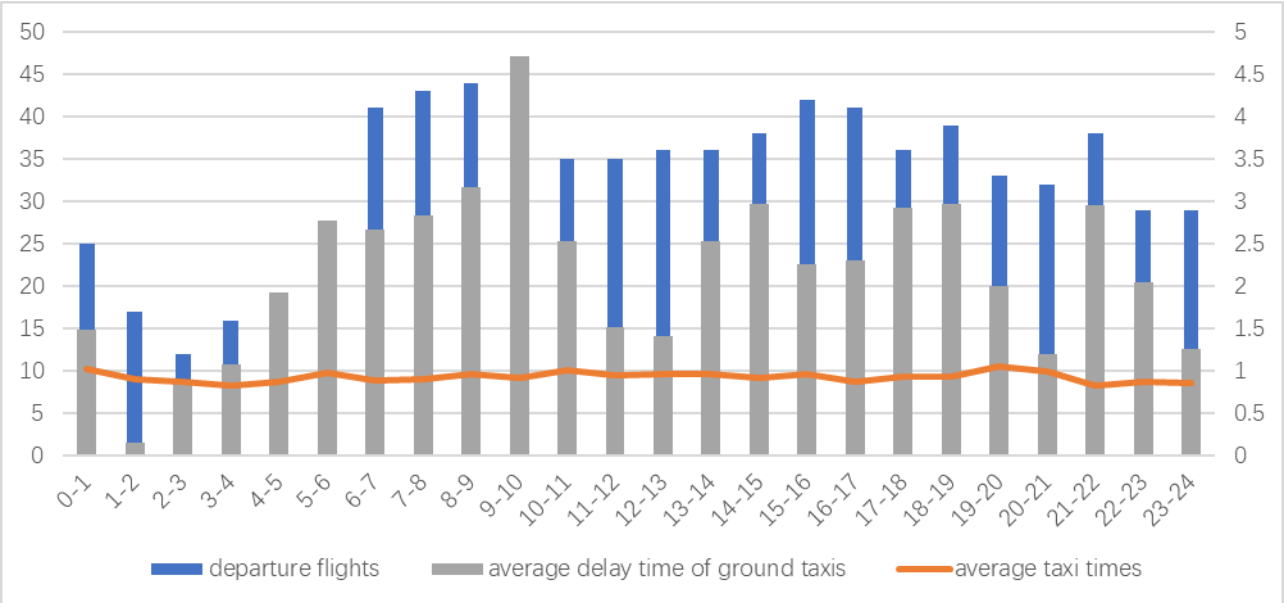

Fig. 6 Statistics of simulated departure flights and departure taxi time and average delay time during peak days

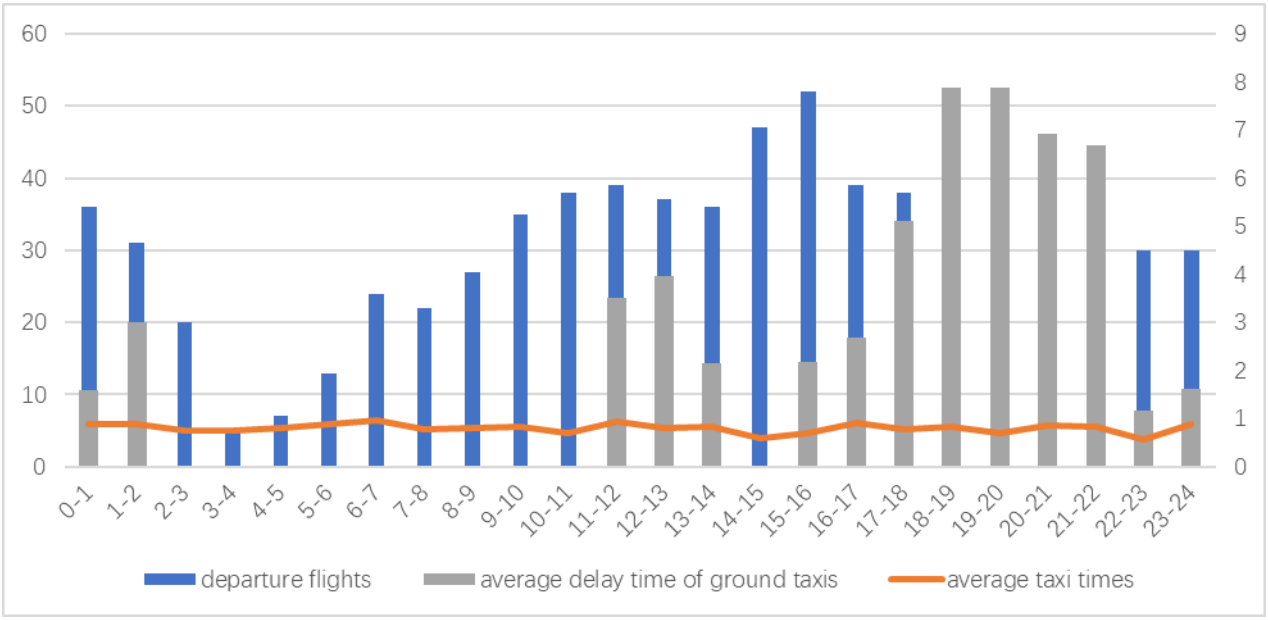

Fig. 7 Statistics of simulated arriva flights and departure taxi time and average delay time during peak days

Statistical analysis data show that through a more reasonable setting of taxi paths in the flight area, the peak hours of departing flights appear at 8:00-9:00, and the peak delay is 9: 00-10:00; the average delay of departing flights It is 2.20 minutes, and the average ground taxi time of each departing flight is 9.349 minutes. Arrival hours during peak hours are 15:00-16:00, peak delays are 18:00-19:00, average delay time for ground taxi for arrival flights is 5.28 minutes, and average ground taxi time for each flight for arrival flights is 5.323 minute.

6. Summary

The running and sliding system of the flight zone of this large international airport is a set of parallel short runways and a set of parallel long runways running simultaneously. It is typical in China ’s airport runway configuration and layout, and has research significance. Through the analysis of the results of the simulation, Parameters such as ground taxi time for inbound and outbound flights, and average delay for departure ground taxi are within acceptable ranges. The design scheme for the flight zone of this large international airport's running and sliding system can meet the long-term actual operation requirements.

The planning of the taxi path of the aircraft in the airport flight zone is very necessary. According to the taxi path planning principles and planning scheme, the simulation model is input, and the simulation is run several times to control the flight delay in 2-3 minutes.

①Taxiing routes should be fine-grained according to the seats in different areas;

②Taxiing path setting should be set as one-way traffic section as possible to avoid taxiing conflict;

③Try to avoid crossing runways and taxiways;

④If there are multiple taxiways at the end of the runway, multiple queuing and waiting queue points can be allocated according to the aircraft position to avoid queue congestion;

⑤Diversion of inbound and outbound flights, making full use of each road of the existing taxiway system.

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