Fukuoka Airport Taxiway Optimization for Runway Duplication

1. Purpose of the Study

In addition to airport capacity, efficiency aspects must be improved as airline demand, which was reduced by the Corona disaster, is expected to recover by 2023 and continue to increase. This is evidenced by NASA and FAA research into streamlining airport ground transfers and departures. In a world of increasing airline demand, aircraft-to-aircraft congestion is a major problem.

Fukuoka Airport, which is to be optimized for this project, is one of the most congested airports in Japan per runway, and delays in take-offs and landings are considered a problem. In addition, since an additional runway will be added in 2024, the optimization of the new runway was considered. In this study, we will address route optimization and taxiway operation at regular intervals for Fukuoka Airport, which will have an additional runway. We will also work to reduce exhaust emissions by decreasing the number of stop sections.

2. Methods and Results

Using Google Map, distance data for taxiways at Fukuoka Airport was obtained. Based on this data, the Dijkstra method and queueing theory were used to find the shortest taxiway route, and a program was constructed to head to an open runway while maintaining a certain interval between runways, making it possible to calculate the time for aircraft to leave the boarding gate, delay time, and to present a new timetable for take-off and landing aircraft. The Dijkstra method used here is an algorithm for solving the single-start shortest path problem, where the starting point is a point on a graph. Queueing theory is a model designed to analyze waiting times. It answers the simple question of a person trying to get in line: "How long do I have to wait?"

3. Conclusion and Discussion

The criteria for an airport to determine that on-time departures and on-time arrivals have not been achieved is when an aircraft is delayed by 15 minutes or more; in 2021, Fukuoka Airport had an on-time departure rate of 95.74% and an on-time arrival rate of 96.05% ([1]). This study has resulted in a 100% on-time departure rate and 100% on-time arrival rate, assuming that passengers are arriving on time, i.e., delays occurring for all aircraft are kept to less than 15 minutes. In addition, since the program is designed to maintain a constant interval, the traffic congestion on the taxiway is equal to zero, which reduces the sense of anxiety among passengers that the aircraft will not take-off yet. In addition, since the aircraft would not have to stop on the taxiway, it would not have to use energy to go forward again, which would greatly contribute to the reduction of exhaust emissions.

Reference

[1] CIRIUM, The-on-time-performance awards 2021