

Taxiway Optimization for Runway Duplication at Fukuoka Airport

1. Purpose of the Study

Aviation demand, which declined during the COVID-19 pandemic, is expected to fully recover to pre-pandemic levels by 2023 and continue to further increase. Therefore, there is a need to improve the efficiency of air traffic control in addition to airport capacity. Particularly, congestion among aircraft is an important problem. In recent years, NASA and the FAA have initiated research on this topic to improve the efficiency of ground transfers and departures at airports. Fukuoka Airport has one of the highest congestion levels per runway in Japan, and the resulting delays in takeoffs and landings constitute a major issue. Therefore, we aim to reduce emissions by optimizing routes, operating taxiways at regular intervals, and reducing stop zones.

2. Methods and Results

Using Dijkstra's method and Queueing Theory, we identified the shortest taxiway routes, constructed a program to head to an open runway while maintaining constant intervals, calculated the optimal time for aircraft departing the boarding gate and the associated delay time, and constructed a new takeoff and landing timetable.

3. Discussion and Conclusions

Airports judge on-time departure or arrival of a flight to have failed in case of delays exceeding 15 min. In 2021, Fukuoka Airport exhibited an on-time departure rate of 95.74% and an on-time arrival rate of 96.05%. This study accomplished 100% on-time departure and arrival rates, assuming that all passengers arrive on time. Furthermore, the program completely prevents traffic congestion on the taxiway, allaying anxiety in passengers over delays in take-off, as it is designed to maintain a constant interval between different runways. In addition, aircrafts are not required to halt on the taxiway in the proposed system; this considerably reduces exhaust emissions by diminishing energy expenditure.