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Increase the Transfer Capacity of Airports

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Abstract--- In this article, question on the topic of the process of increasing the workload of runway in Tashkent International Airport named after Islam Karimov . By considering and researching some world known airports we concluded adding additional two rapid exit taxi ways to its main runway.
Keywords---Airport, Complex structure , Services, Taxiway, Traffics.

Introduction

An airport is a complex of structures that includes an airfield, an air terminal, and other structures intended for receiving and sending aircraft, servicing air transportation, and having the necessary equipment, aviation personnel, and other employees for this purpose.

Airports are vital centers where various services are concentrated. Therefore, they provide a system for ensuring the safety and security of air passengers. Around the world, at most airports, these functions are carried out through coordinated activities carried out by various services.

When calculating the airport capacity, defined as the maximum number of aircraft serviced within one hour, the methods of queue theory are used and the sequence of queues is studied, the movement of which is determined by the number of service centers (runways) and the characteristics of the services provided. A simple analogy to this model is the queue for air tickets, in which each transaction takes a finite amount of time. The number of tickets sold in a fixed time can be increased either by increasing the number of queues (cashiers), or by reducing the customer service time. Similarly, airport capacity can be increased by increasing the number of runways or reducing the time required for a single aircraft to take-off or land by improving the performance of air traffic control.

To determine the capacity of the airport, the methods of mathematical modeling on a computer are used. In the mathematical model of the airport operation, each plane moves in a queue in accordance with some set of rules for providing standard services that determine the speed of the queue. Like ticket sales, the number of planes waiting in line depends on both scheduled operations and random circumstances. The maintenance rules (and, consequently, the maintenance time) of each aircraft also depend in a complex way on the air traffic control rules related to both the airport structure and the aircraft. Airport capacity is calculated on computers using special mathematical models that can reflect the interaction of natural and random influences that exist in the actual operation of the airport. Using these models, the analyst can estimate with high accuracy the capacity of the airport.

With insufficient airport capacity, there are delays in aircraft maintenance. The analysis of delays using mathematical models is complicated by the fact that the delay time is a nonlinear function of a number of parameters, and small changes (for example, due to errors) of the parameters can cause large (and possibly enormous) changes in the calculated values of the delay time. Compliance with the rules of technical operation of the runway ensures a safe interval between

aircraft in adverse weather conditions and reduces the risk of the aircraft falling into a zone of severe turbulence in the wake of a previously flown heavier aircraft. These rules establish the maximum permissible intervals between consecutive take-offs and landings carried out on the same runway, and regulate the movement of aircraft on intersecting runways, as well as contain other requirements that guarantee flight safety. As visibility deteriorates, the acceptable standards become more stringent, the capacity of airports using automated take-off and landing systems or only visual reference points can vary greatly.

Civil aviation airports are elements of the country's air transport system. From this point of view, an airport is an enterprise that regularly receives and dispatches passengers, baggage, cargo and mail, and organizes and services aircraft flights.

To perform these functions, the modern airport has a large number of complex and expensive structures. It is full of automated devices, various mechanization and an extensive network of engineering communications. All this complex of facilities and equipment should ensure the regularity and safety of aircraft flights with a high degree of reliability, allow you to quickly, with great convenience and comfort serve passengers and process significant cargo flows.

The airport master plan should provide the most favorable conditions for the production process and labor at the airport, rational and economical use of land plots and the greatest efficiency of capital investments.The general plan of the airport reflects the entire system of this functional relationship. The conditions, time and cost-effectiveness of technological operations largely depend on how buildings and structures are placed on the master plan.

Airports should change and improve over time due to the increase in the number of passengers and the growth of the population of the city that is nearby.This can be achieved by increasing the density of development, which contributes to a more economical use of land, reducing the length of transport communications and engineering networks, cooperating with the construction of common roads with other enterprises, engineering network structures, social services, etc. Aesthetic, providing architectural and artistic expression of the complex of buildings and structures of the airport

Runways and taxiways are the least flexible elements of an aerodrome and should therefore be considered at the outset when developing its development plan. Forward-looking forecasts should determine changes in the values of the standard of movement of aircraft, the nature of air traffic, types of aircraft and other factors that affect the layout and size of runway and taxiway systems. You should not pay too much attention to the current system requirements, because at later stages of development, requirements that are equally or more important can be ignored. For example, if an aerodrome is expected to serve higher categories of aircraft types in the future, the existing taxiway system should be designed to provide the greatest separation distances that will eventually be required.

When developing a master plan for the taxiway system, the following principles should be considered:

a) The taxiway routes should connect the various elements of the airfield at the shortest possible distances, thus reducing taxiing time and costs;

b) the taxiway routes should be as simple as possible to avoid the need to develop complex instructions and the occurrence of pilot errors.;

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c) to the extent possible, it is necessary to design straightforward routes for taxiing. When a change in direction is unavoidable, the desired turning radius should be selected, as well as widen or increase the width of the taxiway so that it is possible to taxiing at the maximum permissible speed

d) Where possible, intersections with runways and other taxiways should be avoided in the interests of safety and to reduce the likelihood of significant taxiing delays;

e) The taxiway routes should have as many one - way segments as possible in order to minimize the risk of dangerous approach by aircraft and delay. Aircraft flows through these segments should be analyzed for each scheme in which this runway will be used;

f) The taxiway system should be designed to ensure the maximum service life of each component so that the components of the existing system can be used in future renovations; and

g) Ultimately, the functional characteristics of the taxiway system will be determined by its weakest component. Therefore, in the process of designing the system, it is necessary to identify and eliminate its potential shortcomings.

Other important issues should be considered when planning the taxiway system:

a) the taxiway routes should not pass through areas where there is a possibility of free access of people to the aircraft. Special attention should be paid to measures to ensure the safety of taxiing aircraft, especially in those places where acts of sabotage or armed aggression are possible;

b) The layout of the taxiway should be designed in such a way as to avoid interference with navigation aids from steering aircraft or ground vehicles using the taxiway;

c) All sections of the taxiway system should be viewed from the airfield control room. Remote cameras can be used to monitor sections of the taxiway that are shaded by terminal buildings or other airfield structures, if such shading is practically impossible to avoid;

d) The impact of the jet stream on the areas adjacent to the taxiway should be minimized by stabilizing the weathering of the ground and erecting jet deflection shields where necessary to protect people or structures, and

e) The placement of the ILS can also affect the position of the taxiway, since aircraft taxiing or standing on the taxiway can be a source of interference to the ILS.

It is necessary to have a sufficient number of entry and exit taxiways serving certain runways in order to meet the existing requirements for handling take-off and landing aircraft during peak hours. An additional number of input and output taxiways should be designed and constructed based on the expected increase in runway utilization. When planning the elements of this taxiway system, the following principles are applied:

a) the exit taxiway is used to minimize the time of use of the runway by aircraft performing a landing. Theoretically, the exit taxiways can be positioned in such a way as to best serve any type of aircraft that is intended to be received on a given runway. The practically optimal number of aircraft and the minimum interval between them can be established by dividing the aircraft into groups with a limited number of classes, based on the landing speed and deceleration after landing;

b) The exit taxiway should allow the aircraft to move smoothly from the runway to a point outside the runway and thus allow the next runway operation to begin as soon as possible;

c) The exit taxiway can be positioned at either a right or an acute angle to the runway. The first type of taxiway requires the aircraft to decelerate to a minimum speed before leaving the runway, while the second type of taxiway allows the aircraft to descend from the runway at high speed values, thus reducing the time spent on the runway and increasing its capacity (for detailed

information on the position and geometric dimensions of the taxiway with an acute angle (the so-called "rapid exit taxiways"); and

d) to meet the take-off requirements, one exit taxiway on each side of the runway is usually sufficient. However, to ensure traffic volume, consideration may be given to having multiple runway entrances, using detours, and waiting areas.

Taxiways located on aprons are divided into the following two types:

a) an apron taxiway is a taxiway located on the apron and designed either to provide a through taxiing route through the apron or to provide access to the aircraft taxiing lane to the parking lot; and

b) an aircraft taxiing lane that is part of an apron designated as a taxiway and is intended only to provide access to aircraft parking lots.

The requirements for apron taxiways regarding lane width, separation distances, etc., are the same as for other types of taxiways. The requirements for aircraft taxiing lanes are also similar except for the following points:

a) the transverse slope of the taxiing lane is determined by the requirement for the slope of the apron;

b) it is not necessary to include the aircraft taxiing lane in the parking lot in the taxiway lane; and

c) the requirements for the separation distances between the centerline of the taxiway lane and the object are less stringent than the same distances for other types of taxiways.

Aircraft taxiing lines that branch out to parking areas are not considered as part of the aircraft taxiing lane and therefore do not fall under the requirements of the taxiing system.

The evaluation of the options for the taxiway system should be aimed at ensuring the operational efficiency of each system in conjunction with the runway and apron layouts for which it is intended to serve. The more complex the runway, taxiway, and apron master plan, the greater the potential for reducing operational costs by comparing taxiway system options. For this purpose, with the help of consultants, aircraft operators and airport authorities, several models for simulating the flow of aircraft using computers have been developed.

For example, the Federal Aviation Administration of the United States of America has an airfield delay model that simulates all significant aircraft movements performed on the airfield and the approach path to a given runway over a long period of time. In such models, it is possible to consider various input variables, such as:

– the composition of the aircraft;
– the volume of air traffic;
– maximum air traffic values;
– aerodrome diagrams (taxiway and runway);
– the final destination of the aircraft;
– runway layout diagrams;
– taxiway layout diagrams;
– rapid exit taxiway; and
– use of runway-defined aircraft categories.

The values selected for the minimum width of the taxiway are calculated by adding the distance from the wheels to the edge of the pavement to the minimum span of the outer wheels of the main chassis for the selected code letter.

Changes in the direction of the taxiway should be kept to a minimum and as small as possible. When designing the rotation, it should be noted that while the cockpit over centerline taxiway distance between the outer main wheels of the landing gear and the edge of the taxiway was not less than the values.

Conclusion

In conclusion, We believe that adding rapid exit taxiways in Tashkent International airport named after Islam Karimov like in Figure 1.and by doing so we can increase air transportation ability of airport , and it could give us 20 % growth in effectiveness in passenger flow by not changing anything else.

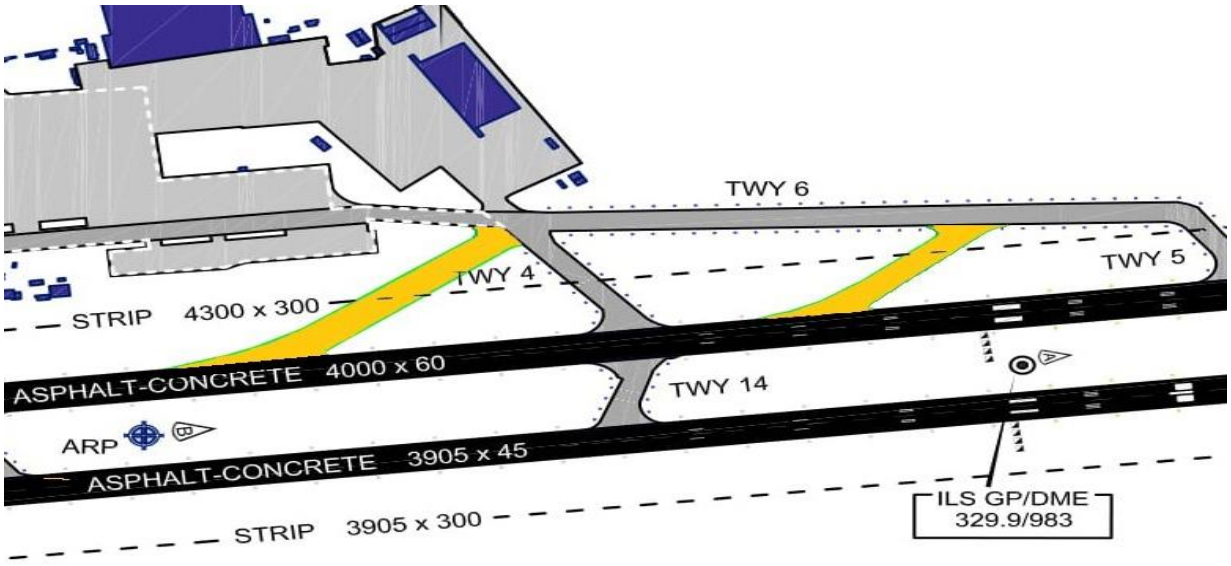

Figure 1. Location of rapid exit taxiways at Tashkent international airport named after Islam Karimov

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