

METHOD FOR CALCULATING THE OPTIMAL NUMBER OF LOADING AND UPLOADING POINTS OF THE AIRPORT CARGO WAREHOUSE

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The cargo complex of the airport is a warehouse of temporary storage of cargo arriving and departing by planes serviced at the airport. The airport operator or handling company services the cargo complex. The cargo terminal carries out ground handling of cargo transported by foreign and domestic airlines, as well as provides freight forwarding, customs brokerage and warehousing services. The airport cargo complex helps you to solve the issues of transportation, warehousing and customs clearance of goods, as well as provides professional advice on all related issues [1].

Freight complexes are classified by volume, based on the amount of daily cargo turnover:

- Group I - more than 300 tons / day;
- Group II - from 150 to 300 tons / day;
- Group III - from 70 to 150 tons / day;
- Group IV - from 30 to 70 tons / day;
- Group V - 30 tons / day.

Cargo warehouses of a modern airport are complex engineering structures, most of which are mechanized and automated. They are equipped with special vehicles and means of mechanization, weighing, transportation and storage of goods and mail, including: stationary and self-propelled lifting equipment and mechanisms; weight measuring equipment; means of transportation of goods and mail; means of loading and unloading cargo and mail to / from the aircraft; means of loading and unloading containers (pallets) to / from the aircraft; engineering and technical means of aviation security; means of detecting radioactive and explosive substances; means of communication, information, radio broadcasting [2].

Serving cargo transportation at the airport requires the creation of special conditions for various categories of cargo:

- valuable cargo - currency in banknotes or coins, securities, credit and bank cards, jewelry, precious metals, precious or semi-precious stones, including industrial diamonds, as well as valuable art objects;
- dangerous goods are products or substances that, when transported on aircraft, can pose a significant threat to the life and health of passengers, flight safety and the safety of property;
- perishable cargo - products of plant or animal origin and their processing, live plants, fish seed, etc., which require special conditions for storage and transportation (optimal temperatures, humidity, etc.) [3].

The main design parameters of this system are the number of operator jobs for paperwork, the number of mechanization and technological equipment for handling cargo at the cargo yard.

The required number of operator workplaces is determined by the formula:

$$n = \frac{\lambda_c}{\mu_1} + \frac{p_1 * t_1}{t_{w1}} \quad (1.1)$$

where λ_c - is the intensity of the incoming cargo flow of consignors for the paperwork; μ_1 - intensity of paperwork by one consignor; p_1 - probability of employment; t_1 - average time of sighting the consignment note, min; t_{w1} - estimated waiting time for shippers in the queue, min.

The required number of means of mechanization in the cargo yard is determined by a similar formula:

$$n = \frac{\lambda_w}{\mu_2} + \frac{p_2 * t_{av}}{t_{w1}} \quad (1.2)$$

where λ_w is the intensity of the incoming flow of cars with cargo to the warehouse from the city side;

μ_2 - intensity of unloading one machine with a load;

p_2 - probability of employment of mechanization means;

t_{av} - average time of unloading a car with a load, min;

t_{w1} - estimated waiting time for a car with a load in the queue, min.

The intensity of service when registering or unloading cargo is determined by the formula:

$$\mu = \frac{1}{t_{ser}} \quad (1.3)$$

where t_{ser} is the average service time, h.

The average waiting time in the queue for cargo clearance or the performance of loading and unloading operations is determined by the nomogram. The nomogram allows you to determine the value of $T_{av} = \mu * t_w$ depending on the average number N_{av} of working racks or mechanization means, ensuring the absence of unlimited increase in the length of the queue.

The value of N_{av} is determined by the formula:

$$N_{av} = \frac{\lambda}{\mu} \quad (1.4)$$

The estimated waiting time for cargo clearance or loading and unloading operations is determined based on the average waiting time using the Pollachek formula:

$$t_{w1} = t_w \left(\frac{1+k^2}{2} \right) \quad (1.5)$$

where k is the coefficient of variation of the service time (0.6-0.8).

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