

*G.M. Agieieva, Cand. Sc. (Engineering),  
(National Aviation University, Ukraine)  
L.I. Kriveljov, Cand. Sc. (Engineering),  
(State Enterprise «State Research Institute of Building Constructions» (NIISK),  
Ukraine)*

### **Transformation of pedestrian route schemes in the parking – air terminal zones in the course of airport reconstruction**

*The paper covers the results of the study of pedestrian route schemes on the terminal square, including multi-story parkings. Design decisions on compliance with regulatory requirements at Boryspil International Airport are analyzed. Principle solutions to reduce the length of pedestrian routes and travel time are presented.*

Airports are transport enterprises with complex functions, where the flows of air and ground transport users intersect. The ground component of the organization of transport services for airline passengers and airport visitors provides a significant share of organizational and technological processes. A number of them are related to the distribution of passenger flows when transferring from one type of transport to another, in particular, private cars, on terminal squares, in transport and transfer hubs which are a part of or next to air terminal complexes. In contrast to transport and transfer hubs, terminal squares are a mandatory part of air terminal complexes. The design solution of terminal squares is relevant in ensuring level of comfort stay and service of airport visitors and public and private transport flows [1, p. 38]. The level of comfort is an integral indicator, which includes the length of pedestrian routes from ground transport stops to air passenger service areas.

For single-station air terminal complexes, the most common are terminal squares arranged according to a dead-end scheme with entry / exit from one side. Transport stops are located along the front of the air terminal complex, and the main area of terminal square is allocated for car parking space.

The development of airports, the stage by stage build up of the territory around the perimeter of terminal square is accompanied by an increase in throughput capacity and an increase in the need for car parking space. The increase car ownership rate of the population, which, in particular, is high for the countries of the European region – 500-600 cars per 1,000 inhabitants – also affects the growth of the need for parking space [2, p. 167].

Update and reconstruction of airports, transformation of those into multimodal complexes, transport hubs face a number of problems related to the need to reorganize, first of all, terminal squares, and, as a result, pedestrian routes and road traffic. Similar problems arise in cities, in particular, in railway terminal areas [3, p. 224]. The problems are similar, but when developing design decisions, some differences and peculiarities should be taken into account.

The length of pedestrian routes is a regulated value; travel time is also limited. The design regulations – DBN B.2.2-12:2019 – provide the restriction up to 100 m on the length of pedestrian route at the transfer stations. It is referred to the distances to

stations of urban off-street and extra-urban transport that connect the airport with the city center, other airports and settlements. For airports that are part of transport hubs, the range (length) of pedestrian routes to stopping points which are a part of the facility is limited to 200 m (for international transport hubs), 100-200 m (for regional (suburban) hubs) and 100-150 m (for city and district hubs). Loss of time for transfers at transport interchanges are up to 10 minutes taking into account the waiting time.

Particular attention should be paid to parking especially multi-storey parking [4, p. 54] which is not listed. There is a strong need for parking space at up to date airports, so the following steps are essential:

- to make extra space for short and long-term car storage for visitors and airport employees. This can lead to planning of several parking zones of different capacities, floors and location with regard to different terminals, etc.;
- to make traffic patterns, to define locations and sizes of city-airport express bus parking zones.

The analysis of general layout and complex schemes of airport traffic shows that in the case of construction of parking at a considerable distance from the air terminal complex (passenger terminal), the use of free internal port vehicles is expected to reduce travel time. This practice, in particular, was used in long-term storage parking at Barcelona International Airport between terminals T1 and T2.

The situation is different at Boryspil International Airport. The construction of Terminal D with a capacity of 3,000 pas/h led in practice to a situation where the terminal square in front of Terminal B lost its functions and was redesigned and turned into several single-level parkings [1, p. 39], with the distance from terminal D to these parkings being considerably higher than the standard value of pedestrian route length.

The construction of an open above-ground multi-story parking located parallel to Terminal D was supposed to satisfy the need for 2,038 car parking spaces [5, p. 12]. The linear building of the parking is located at a distance of 50 m from the facade front of Terminal D. Both buildings are connected to each other by an overhead closed passage in the central part of the parking [5, p. 13].

The dimensions of the parking blocks located to the left and right of the transition zone, lay out of car parking spaces and the movement of vehicles indicate that the length of pedestrian route in the car space – transition – terminal D direction considerably exceeds the standard value.

The presence of cargo – travel bags and cruise suitcases – significantly worsens the situation in terms of time and optimal direction of movement! These zones were discovered during work on scientific and technical support of the construction of a multi-storey parking at Boryspil International Airport [5, p. 19].

In order to improve the situation and solve this problem, several options of design, structural, and engineering solutions aimed at reducing the length of pedestrian routes and travel time were presented.

First, two additional transitions from parking blocks can be constructed. But this may affect the site space planning of Terminal D and introduce changes in passenger service technology, in particular, reduce the area of individual zones.

Secondly, it is possible to solve the problem of optimizing schemes and reducing the length of pedestrian routes thank to construction of open galleries at the third level of parking blocks for the movement of electric shuttle and ensuring the

high-speed movement of pedestrians; elevator extensions for the vertical communication of pedestrians, etc.

Both options are costly.

### Conclusions

Parking can be considered as component of terminal squares, intended for short and long-term storage of motor vehicles. Urban and design decisions of airport parking are influenced not only by their capacity, and the traffic scheme, but also by restrictions on the length of pedestrian routes and travel time from the parking to the air passenger service areas. One of the options for solving this problem is the construction of multi-story parking. But this is not a panacea either.

The proposed solutions regarding the Boryspil International Airport can be taken into account when developing road traffic patterns and pedestrian routes in new design decisions and solutions for modernization and reconstruction of existing multi-story parking.

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