

AIRPORTS AND AIRPORT INFRASTRUCTURE

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CONCEPTION OF DEVELOPMENT OF THE STATE INTERNATIONAL AIRPORT BORYSPIIL

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Analysis of existing conceptual variants of development of the State Boryspil International Airport and new conception variant with prognosis of economic efficiency is presented.

Introduction

The possibility of development of air transport system in Ukraine, as much as general economic development of state directly depends from functioning of the airport Boryspil.

Due to its favourable territorial supremacy airport Boryspil is the optimal transport centre in Ukraine.

Development of the airport Boryspil promotes upturn of passenger and cargo traffic, increase of business activities, entry of high technologies in Ukraine, development of international economic links, integration of Ukraine in the world economy. The main strategy of the airport Boryspil is directed on increase of volume of international connections.

At present neither the equipment nor the technical condition of the international airport Boryspil meet the requirements put to airport of the given class and appointment. That is why the conception of development of the state international airport Boryspil comprises the significant aspect of its functioning in accordance with the present international standards.

The airport Boryspil has two runways with parallel magnetic directions for take-off and landing. Intensity of air traffic is determined as for aerodrome with independent runways [1]. If we take a plane with capacity of 170 passengers as a calculation unit, the annual air traffic executed from the mentioned runways will comprise 19–21 million passengers per year. Not only resources of runways, but also traffic capacity of buildings and installations assigned for service of air passengers, in the first place air terminals must conform to such quantity of passengers. There appears necessity in additional territories for placing the objects of servicing infrastructure for passengers, cargo and aeronautical engineering resulting from further increase of air traffic.

Development of the main central international airport of Ukraine is one of major tasks of state politics for the next 10 years.

Conception of central international airport requires that development of its powerful infrastructure within unified technological complex including numerous objects of passenger and cargo air traffic services, transit zones, custom warehouse, hotels, communications etc. should be provided for.

Analysis of investigations and publications

In 1995 Ukraeroproect prepared a project, which envisaged complex reconstruction of internal and external networks and installations of engineering provisions and transport in turns of construction process.

The analysis of perspective development of airport Boryspil up to its limit, in accordance with volume air traffic was fulfilled in this project; it determined limits of territories, which border the airport and where it is possible to prospectively enlarge the airport Boryspil up to its full development, taking into account three-runway aerodrome; it also gave estimations of perspective of organization of transport service activities of airport.

Master plan of complex reconstruction and enlargement of the international airport Boryspil was developed for three periods: up to 2005; for 2012 as the accomplishing year; in the long term – prospective growth of the airport up to its full development.

The drawback of the given project is the fact that it envisaged new hangars for maintenance, washing and painting of aircraft only for two airplanes B-747, while with appearance of the new passenger air liner A-380, that is much bigger in size than B-747 it became unreasonable to construct such hangars. There is a need to build a hangar for two A-380 for immediate perspective inasmuch as this plane will shortly begin to transport passengers, and the airport Boryspil has to provide maintenance of this aircraft since it should be transformed into hub (junction airport) in the near future.

In 2003 Ukraeroproect prepared another project [2].

The disadvantage of this project consists in planning to start the construction of a new air terminal only in 2007. It may reduce economic advantages to minimum since by that time similar transcontinental airports would be already built in neighbouring countries (Russia, Poland). These circumstances would temporarily cause the recession in use of new air terminal of the state international airport Boryspil. Its bringing into operation was planned for 2009. We think it is necessary to accelerate construction works and to start building in 2006.

Formulation of a problem

The purpose of this research is to propose a new variant of conception of development of the state international airport Boryspil and to give the estimations of its economic efficiency.

Obtained results of the research

Increasing air traffic requires construction of additional objects of servicing infrastructure for air passengers, cargo and aeronautical engineering.

Taking into account the necessity to guarantee in perspective the maximum possible intensity of aircraft traffic, it is necessary to reconstruct the aerodrome covering of airfield #2. Runway #2 does not meet the requirements either for airplanes of all types that are in operation now, or for a new extra-heavy aircraft A-380 (A-380F). Therefore, it is necessary to reinforce the mentioned covering. Prior to such reinforcement the existing reinforced concrete aerodrome covering of runway #2 requires preliminary investigations and selective repairs, taking into account the destruction of plates and their sagging.

It is also necessary to place runway #3, which will serve for reception of aircrafts of small capacity (up to 100 passengers). Taking into account the cartographical study, the runway #3 may be placed at angle to runway #1 and runway #2. Runway #3 will cross the southern butt-end of runway #2. Runway #3 will make it possible to perform take-off and landing of planes in the opposite directions at the same time, especially under gentle breezes and with the purpose of unloading runway #1 and runway #2. The necessity in building of a new hangar appears in connection with the planned increase of air traffic and growth of the attributed park of national air companies that are based at the international airport Boryspil. Aircraft A-380 (A-380F) is adopted as calculation type for determining of geometric dimensions of hangar. We consider that the arrangement scheme of aircraft in the hangar is a dead-end one-row.

We determine overall dimensions of hangar at plan as a sum of distances, which are occupied by aircraft, dock platform and thoroughfare [2].

Estimated overall dimensions of hangar are 180*84 m and inner height is 30 m.

In the project of complex reconstruction it was proposed to take for comparison a hangar for maintenance of two aircraft B-747 with overall dimensions 136*84 m and inner height 26,5 m that evident from calculations is not fit for maintenance of two aircrafts A-380.

Preliminary washing of aircraft is carried out prior to their preventive and routine maintenance. These procedures are provided in the open air but the increased ecological requirements to objects using this technology cannot be granted if cleansing of aircraft with scouring cleanser takes place out of doors especially under unfavourable climate conditions.

In connection with the mentioned factors, the necessity arises to build a hangar for aircraft washing. Building of such hangar will provide particularized technology of washing and removing of ground-based ice from airplane. It is necessary to foresee that the overall dimensions of this hangar were the same as for the aircraft maintenance hangar.

Hangar for painting of aircraft is supposed to be made in metallic framework by analogy with the project of hangar for two aircraft A-380 (A-380F) with all necessary provisions for technology of washing and painting of the wide-fuselage airplanes. Taking into account the prognosis of the freight transportation up to 2012, there is a necessity in stage-by-stage expansion of the freight terminal warehouse areas. In this connection appears a necessity in development of the freight ramp for parking cargo airplanes of type IL-76 and for the perspective – of super heavy A-380F.

Taking into consideration that the existing control tower (CT) in the near future will not satisfy normative and technological requirements for providing of the visual control of the take-off and landing of the aircraft, it is necessary to construct a new independently standing control tower. Also, it is necessary to build a two storey operational centre, radar building and meteorological service building in complex with the CT, as the results of the research demonstrate it. It should be reasonable to place the control tower close to a new antenna field of CT to the south of the existing apron. It is proposed that the base of tower should be constructed of the precast reinforced concrete collectors. Inside the tower it is envisaged to install the cargo-passenger elevator.

Taking into account the forecast of transportation volumes for the designed 2012, the total capacity of the air terminal complex of the airport Boryspil will be: minimum – 1700, average – 2800, maximum – 4500 pas/hour [1].

Existing area of 23000 m² of functioning passenger terminals makes it possible to handle up to 2 million passengers annually. After reconstruction of terminal “B” the servicing level of the foreign passengers sufficiently increased. But the disadvantage of the terminal “B” is that passengers start obligatory formalities on the ground floor and finish on the first floor. Thus, the servicing level of the foreign passengers in terminal “B” is satisfactory, but it does not meet the European standards. So, it is recommended on the basis of calculations to construct a new air terminal complex with capacity of 2000 pas/h [3] for servicing of arriving and departing passengers, guests of the airport, which is the optimal decision in this case. Coming from the analysis of general plan of the state international airport Boryspil and its perspectives of development for the next 20 years it is recommended to realize the conception of the linear air terminal complex, which has the following advantages: minimal foot distances under decentralized registration; more simple orientation for passengers; simple enough design of the main air terminal; separation of arriving and departing passengers is achieved considerably easy by using passages in controlled area of the airfield; optimal time span for registering start and finish.

In perspective the expansion is possible without obstructions for servicing of passengers and aircraft flights. Such expansion could be fulfilled by linear elongation of the existing block or construction of a new linear block, which would lie within controlled part of the airport [1].

Further consolidation of international connections, which is actively promoted by development of international air communication, results in growing number of business trips in Ukraine and Ukrainian businessmen visits to other countries. Creation of business centres and offices directly in the airport gives a possibility to solve in complex many problems of commercial activities of different companies. It is foreseen to place business centre opposite to the air terminal within the same block with parking lot for 600 cars.

Transformation of the airport Boryspil into transcontinental airport causes sharp necessity in construction of a new hotel.

The hotel complex will include: 1–2 beds rooms; top category family rooms; suits; mother and child rooms; restaurants; bars; shops. Business rooms and two conference halls will be foreseen for business meetings. It is proposed to place the hotel complex to the North of the business-administrative centre and parking lot, opposite the existing three-star hotel.

The potential effectiveness of a new air terminal complex is esteemed basing on possibilities of achieving the set goals as the result of fulfilment of project.

Practical benefits of the suggested project consist not only in improvement of transport communication inside the state but between Western and Eastern countries as well.

The economic effectiveness of the future transcontinental airport is the primary objective of the project [4]. Construction of the air terminal complex is an economically attractive project, but of low effectiveness. That is why it needs financial support to increase its effectiveness [5]. In this case, the state controlled airport managed to secure a 30-year low-interest loan from the Japanese government for construction of a new terminal for 2000 pas/h. The remainder of the total cost of the project is to be covered by the airport. Construction is scheduled to start in 2007 and finish in 2009. This project will secure development of the regional infrastructure and the state on the whole.

Estimation of the project effectiveness touches a few aspects, the most important of which are based on the conception of the alternative and temporary cost of money, as of a restricted resource, and is characterized by the system of indexes, which represent relation of expenses and profits concerning the interests of its participants [6].

The indexes of economic effectiveness, which determine expenses and profits of the project for air terminal complex of the airport Boryspil, were obtained in the result of scientific investigation.

Estimation of the future expenses and results of the investment project is held within limits of the calculation period. Let us consider a 10-year period after bringing of air terminal into operation. It is possible to give the complex project value estimation basing upon the following indexes:

- neat profit value (NPV);
- coefficient of profits/expenses (P/E);
- period of expenses pay-off;
- internal rent rate (IRR).

Criterion of coefficient P/E consists in choosing projects where coefficient P/E is more than one. The selection according to the criterion $T_{\text{pay-off}}$ means that a project with the shortest term of pay-off is approved. IRR represents the discount rate that equalizes the reduced profit value with the reduced expenses cost of the project. It is equivalent to that fact, that it equates the neat profit value to zero [4].

The main income resources of the new air terminal complex are profits from its aviation and non-aviation activities.

Incomes from the aviation activity of the air terminal complex are determined on the basis of the predicted quantity of services and tax rate on exploitation of terminals by different aviation companies. It also includes providing aviation safety, which is reached with the help of new control tower, and land servicing of the aircrafts [7]. The profitability of the airport will be additionally supported by means of using a newly built hangar for 2 aircraft A-380, complex of centralized refuelling, cargo terminal and large apron. It will be possible to include profits from a new hotel for 500 guests, business-administrative centre and parking lot for 600 cars into the incomes gained from non-aviation activity of the airport.

Taking into account all these factors, the expenses of the airport necessary for project realization were calculated. They include investments and expenses connected with its operational activity.

For planning of industrial expenses the method of analysis and accounting over the items of expenditure is used: material expenditures, depreciation charges, expenses on personnel and other line expenses.

The forecast of investment economic effectiveness indexes is: pay-off period $T_{pay-off} = 6,2$ years; internal norm of profitability, $IRR = 19,2\%$; coefficient Profits/Expenses $P/E = 1,48$. The mentioned indexes determine the grade of effectiveness and expediency of realization for the project of air terminal complex state international airport Boryspil. The obtained results are positive.

Increasing volume of transportation, designing of the new air terminal complex for 2000 pas/h and exploitation of extra large airplanes A-380 requires improvement of transport connections (airport – Kyiv – airport). The following conceptual directions could solve such tasks: connection to existing highways and railway lines, reorganization of the access roads.

In perspective it is possible to bring railway transport (electric train) directly to the territory of the airport air terminal complex.

The prospective general plan of development of Kyiv foresees connection of the airport Boryspil to the new highway Kyiv–Boryspil from the southern side of the airport.

After 2012, taking into consideration the functioning of the airport as transcontinental, it will be possible to construct a monorail road. The alternative for monorail road can be construction of: a special line of subway; a high speed highway parallel to the road Kyiv-Kharkiv; a special double line railway within borders of Kyiv and construction of the additional bridge over the Dnipro river. At the same time, there is a perspective to make provisions for a high-speed railway line coming near the airport Boryspil [3].

Conclusion

Proposed conception of development of the state international airport Boryspil, in comparison with existing projects, provides a number of additional and modified structures (hangar for servicing of two extra-large airbuses A-380, control tower, cargo apron, business-administrative centre with parking lot, hotel and other structures). It is necessary to note that in the course of development of the air terminal complex not only technological effectiveness should be considered. Economic effectiveness is of principal significance for investors and finally for the state, in view of project profitability.

The fulfilled researches show that the proposed conception of development is economically profitable.

Literature

1. *Руководство по проектированию аэропортов* (Дос 9184). Ч.1. Генеральное планирование. – ICAO. – 1987. – 208 с.
2. *Викторов Б.И.* Специальные сооружения и здания аэропортов: Учеб. для студ. вузов. – М.: Транспорт, 1978. – 365 с.
3. *Airport Development Reference Manual.* – IATA. – 1995. – 309 p.
4. *Москвін С.О., Вербя В.А., Новіков В.А.* Проектний аналіз: Навч. посіб. – К.: Лібра, 1998. – 368 с.
5. *Антонов А.М., Скорописцева З.В., Авсеєнко А.А.* Экономика аэродромного строительства: Учеб. – М.: Транспорт, 1983. – 214 с.
6. *Липиц И.В., Коссов В.В.* Инвестиционный проект: Методы подготовки и анализа. Учеб.-справ. пособие. – М.: БЕК, 1996. – 362 с.
7. *Экономика аэропортов: Руководство* (Дос 9562). Ч. 1 // ICAO.– 1987.

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Концепція розвитку державного міжнародного аеропорту Бориспіль

Запропоновано аналіз існуючих варіантів концепції розвитку державного міжнародного аеропорту Бориспіль і новий варіант концепції з прогнозуванням економічної ефективності.

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Концепция развития государственного международного аэропорта Борисполь

Предложен анализ существующих вариантов концепции развития государственного международного аэропорта Борисполь и новый вариант концепции с прогнозированием экономической эффективности.