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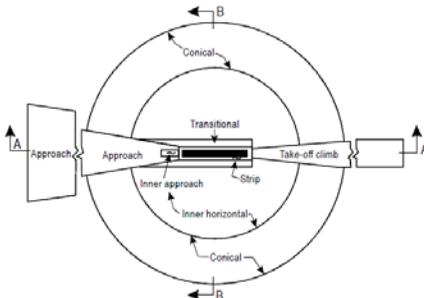
Problems of influence of urban infrastructure on aviation safety of modern airport

The influence of urban infrastructure development on aviation safety in modern airports is analyzed. Collision risks of an aircrafts with high-altitude obstacles on the aerodrome territory, risks to third parties, the zones of constraints on the impact of aviation noise and area of environmental safety are considered.

Airport in the city has a strong positive effect on its development: aviation transport provides a great contribution to passenger traffic, which promotes transport infrastructure growth. However, the development of urban infrastructures, in particular the construction of new high-rise buildings, can create a number of problems for the aerodrome.

In accordance with the requirements of ICAO Standards and Recommended Practices, the aerodrome is a designated part of the earth or water surface (including any buildings, structures and equipment) intended to be fully or partially used for arrival, departure, movement, parking and maintenance of aircrafts. The aerodrome has its own territory – a part of the earth's surface with a radius of 15 km with a center at the control point of the aerodrome (a point which determines the geographic location of the aerodrome.)

The specific of the technological operations provided by the aerodrome (taxiing, take-offs, landing of aircrafts) imposes certain restrictions on areas near the aerodrome territory. It is clear that there should be no obstacles that could interfere with those parts of the earth's surface, over which the flights of the aircraft are carried out, namely the descent of the aircraft during the approach, climbing after take-off etc. That is why, in the aerodromes, the domestic and international regulatory standards have established certain restrictions on the imaginary surfaces that have specific dimensions and angles of inclination, [1, 2], Fig.1.



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Fig. 1. Obstacle limitation surfaces on the civil aviation aerodrome

would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of airplanes. "

When conducting an assessment of the possibility of constructing an object, classified as an obstacle in a certain zone of the aerodrome territory, it is necessary to consider several factors of "safety" of this zone, namely, the restrictions for constructing new high-altitude objects in this zone in order to minimize:

- consequences of the negative influence of aviation noise and electromagnetic radiation on the inhabitants and visitors of the this object;
- the consequences of negative environmental impact through the airplanes' operations;
- consequences of negative influence on the ornithological situation in the aerodrome zone;
- risk to third parties;
- risk of collision of an aircraft with an obstacle that rises above the imaginary obstacles limitation surface.

An analysis of the obstacle location and the approximate definition of the area in which the obstacle is located allows us to make a preliminary conclusions about qualitative analysis of collision risk with an obstacle, which allow to conduct more accurate quantitative analysis in the future. Clarification of zones boundaries requires more detailed calculations of risks.

The physical dimensions of the zones shown in Fig. 3, is the result of a preliminary qualitative analysis. In any case, for each obstacle, a quantitative determination of the airplane collision risk must be carried out.

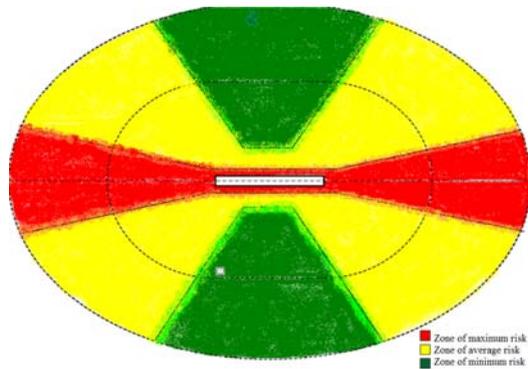


Fig. 3. Diagram with results of qualitative analysis of airplane collision risk with obstacle at the aerodrome territory.

The maximum risk of airplane collision with an obstacle (red zone) exists within the areas of the earth's surface, which are located under the projections of the obstacle limitation surfaces during take-off and approach and near the physical runway boundaries.

Maximum risk value at specified areas may be explained by executing of landing and take-off operations directly above these zones and proximity to the runway.

The realization of hazards may lead to landing or take-off the aircraft with altitudes which do not provide a minimum margin above the obstacles, which in turn can lead to dangerous convergence or collisions with them. Additionally, a violation of the accuracy of the guidance or human factor may result in a landing before optimal touchdown zone or after it, which can also lead to rolling out the runway, so the risk of collision in these areas is considered as maximum.

A preliminary analysis of the public safety zone regarding the conditions of the risk of aviation incidents and accidents (risk to third parties) indicates that the construction of new high-altitude objects in these areas should be prohibited because of the maximum risk to third parties, and also because of the negative noise (sound) and environmental impacts from aircrafts flights in areas of public safety.

The average risk of collision with an obstacle (yellow zone) exists on the Earth's surface areas within the borders of the projections of the internal and external horizontal obstacles limitation surfaces, which are adjacent to the zones of maximum risk. Depending on the location of the obstacles, they may create a risk of collision with the aircrafts in case of continued take-off, missed approach, overrun landing or precision/nonprecision approach with critical engine failures, and / or failure of systems of control the trajectory parameters of the aircraft. In these cases unfolding moment is created in the direction of the obstacle, which the crew of the aircraft can not compensate quickly.

The preliminary qualitative analysis of risks to third parties indicates that the construction of new high-rise objects in these zones must be accompanied by calculations of risks to third parties, and also, taking into account the negative noise (sound) and environmental impacts from aircrafts operations. In addition, in determining the risk to third parties, the aircrafts' trajectories should be taken into account during missed approach and turns in the aerodrome zone.

If the construction of a new obstacle is planning on the part of the earth's surface located within the projection of any trajectory of the airplane movement in the aerodrome zone, the risk to third parties will be higher than, for example, for a house located in the same zone but outside of the projection of the trajectory of the aircraft movement.

The minimal risks of collision with obstacles (green zone) exists on areas of the earth's surface, within the projections of the inner and outer horizontal obstacle restrictions surfaces, adjoined to the middle of the runway on both sides and diverge in different directions to the boundaries of the outer horizontal surface. Obstacles located in this zone create a minimal risk, as they are located at large angles, to the trajectories of the aircraft during take-off and approach to landing and landing.

The risk of collision is significantly increased in case of the realization of hazards during extended take-off or interrupted landing with the failure of a critical engine or control system trajectory parameters of the aircraft, creating unfolding moment in the direction of an obstacle that can not be overcome. The risk to third parties in this zone is also minimal.

Qualitative analysis of the "safety" of the zones at the aerodrome territory will allow preliminary determine and assess the collision risks of aircraft with the obstacles and risks to third parties. Only if the obstacle is located in the "safe" zone, which must be proved by appropriate justifications and calculations of the values or indices of risks, construction of a high-altitude obstacle at the airfield territory of the modern airport is possible under condition that it will not influence the operation of aerodrome aeronautical equipment etc.

Conclusions

1. The construction of new high-rise buildings at the aerodrome territory of the modern airport is a natural irreversible process of development of the infrastructure of the big city.

2. The possibility of construction of a high-rise obstacle at the aerodrome territory of a modern airport should be proven by applying a systematic approach to assessing the "safety" of the obstacle location zone and the obligatory condition for identifying and assessing all possible risks associated with the obstacle (the overall dimensions of the obstacle, the presence of other obstacles in the zone, the impact on the ecological, ornithological situation, etc.).

3. The presence of high altitude obstacles in the aerodrome territory may in the future lead to the introduction of restrictions on the performance of technical operations at the specified aerodrome, for example, the establishment of larger climb gradients during take-off, etc.

References

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2. Сертифікаційні вимоги до цивільних аеродромів України. – (Наказ Державіаслужби України від 17.03.2006 р. № 201).

3. Наказ від 30.11.20012, № 721, Зареєстровано в Міністерстві юстиції 24 грудня 2012 року за № 2147/22459. Про затвердження Порядку погодження місця розташування та висоти об'єктів на приаеродромних територіях та об'єктів, діяльність яких може вплинути на безпеку польотів і роботу радіотехнічних приладів цивільної авіації.