IMPACT OF AIRPORT PUBLIC SAFETY ZONE ON SPATIAL PLANNING

Stanislav Pavlin, PhD, Matija Bračić B.Eng
Faculty of Transport and Traffic Sciences
Vukelićeva 4, Zagreb, Croatia
stanislav.pavlin@fpz.hr, +385 1 2380-214

Abstract

Air transport is a safe mode of transport. Accidents which sometimes happen show that most critical phases of flight are take-off and landing. Recognizing the problem, the developed world countries have decided to establish a public safety zone at busier airports. This paper will cover the experience of western European countries, primarily Great Britain, and display the results in the form of risk that they pose to third parties at several European airports. Subsequently, the impact of the public safety zone on spatial planning in the vicinity of the airport will be determined and guidance will be given related to future planning. The application of UK rules of limited development in public safety zones will be shown on the example of Airports Ljubljana and Zagreb.

Keywords

Airport public safety zone, spatial planning, airport planning

1. INTRODUCTION

The airport is a defined area on land or water (including buildings, installations and equipment) intended, in whole or partly, for arrival, departure and movement of aircraft on the ground. The most important object on the airport is a runway. Physical characteristics of the runway and adjacent surfaces are defined based on global experience in the early 1950s by the International Civil Aviation Organization (ICAO), in Annex 14 to the Convention on International Civil Aviation, which has been amended over the period until today. [1]

Runway is defined as a rectangular area at the airport on the ground, prepared for take-off and landing. Its length is determined by the characteristics of the aircraft which are expected at a specified airport and physical characteristics of the location (altitude, longitudinal slope of runway, reference temperature). The width of the runway is prescribed up to 60m and depends on the width of the airplane wheel track and wing span and reference runway length. Runway is surrounded by the runway strip, usually a natural aligned terrain that is mostly grassy, without objects, and up to 300m in width. It is used in case where plane runs off from the runway in landing or take-off, to reduce damage.

Next to the runway strip there is the runway end safety area (RESA) at either end of the runway which extends symmetrically from the runway centerline up to 120m in width and up to 240m in length.[1]

Take-off and landing are the most critical phases of aircraft flight. The shares of accidents that occur during initial take-off and final landing in the total number of accidents exceeds 70%. [2] Statistically, the distribution of accidents at the airport and its surroundings, is formed by data monitoring the number of aircraft accidents between 1970 and 1989 for take-off and landing and is given in Figure 1.[3]

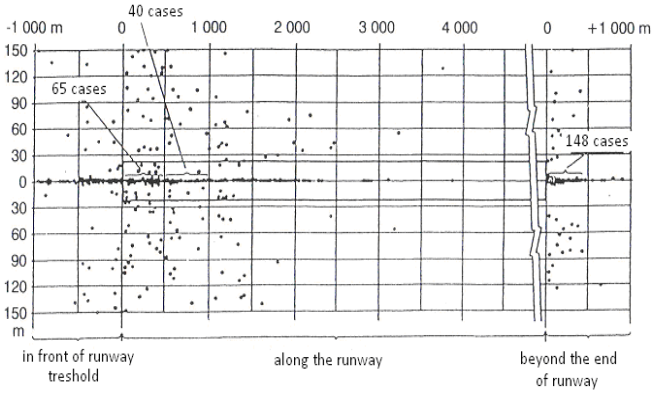

Figure 1: Place of aircraft accidents at take of and landing for small and large aircraft

Figure 1 indicates that the largest number of aircraft landing accidents occurs before the runway threshold to a distance of 1km, but with a significant proportion of accidents 500m to the runway, as well as at the first 1km after threshold.

During take-off the largest number of accidents was recorded immediately after the end of the runway along the extended centerline in the length of about 500m; as the distance from the end of the runway increases, the probability of a plane crash decreases. In this area 148 aircraft accidents occurred (see Figure 1).

Analysis of the total number of all accidents in take-off and landing resulted in the conclusion that the largest number of aircraft accidents occurred on the runway extended centerline and on the left and right side of the runway centerline.

However, a significant smaller portion of aircraft accidents happen outside this area, at a distance of up to 4.5km. [4] In this area there are various infrastructure facilities and traffic infrastructure, which represent a risk to population that lives, works or resides in them and for person on board.

People who live or work in (or pass through) these areas are exposed to a certain degree of risk; called third party risk. An example from the past which confirms this claim is the Boeing 747-200 airplane accident at the Amsterdam Airport/Schiphol, the Netherlands on 4th October 1992. A few minutes after take-off two engines on the plane failed. In an attempt to return to the airport the pilot lost control and the aircraft crashed in a residential zone. About 50 apartments were destroyed, 39 person were killed on the ground and four person onboard lost their lives.

Therefore, to protect people on the ground, most western European countries developed in 1960s the public safety zones. Today, the public safety zones have been established at most western European airports. The main proposed of public safety zone is spatial planning in the vicinity of airports.

2. PUBLIC SAFETY ZONE DEVELOPMENT

Public safety zones are located next to the ends of the runways or runway strips at the west European airports. As most aircraft accidents happen during take-off and landing, it is necessary to define the public safety zone risk contour for the purpose of minimizing obstacles in that area.

In the beginning of public safety zone development most airports accommodated piston engine aircraft. Those aircraft had steeper descents on approach and landing and a very low angle of climb at take-off. The runway length for propeller aircraft was about 1 to 1.5km. Airports were usually built at the outskirts of the cities and the areas in the vicinity of the airport were less densely populated. The first public safety zones appeared in 1958 in the UK and had a trapezoid shape as shown in Figure 2.

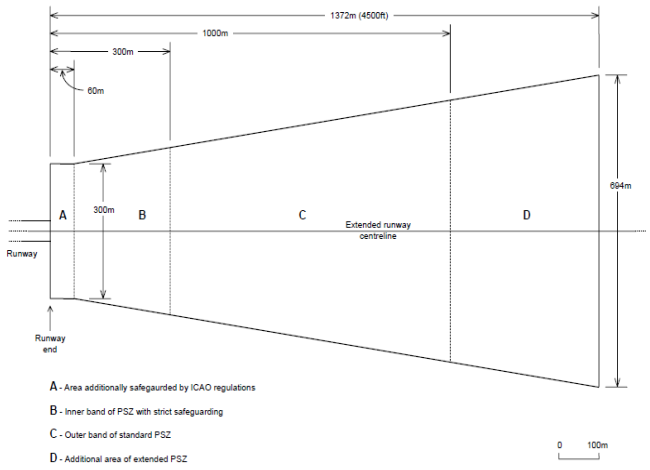

Figure 2: Public safety zone in the 1950s [4]

Airports with over 45,000 operations have a public safety zone in the length of 1,372m (4,500ft), and those with fewer operations zone feature a length of 1,000m. The reason why the trapezoid shape was chosen lies probably in the fact that ICAO defined similarly shape in its regulations, the obstacle limitation surfaces through which no objects can penetrate. [1]

Modern heavier turbojet aircraft were in use since 1960s with higher speeds requiring runway length of 2.5-3.5km. These aircraft approach at very low angles at about 3º and take off with a much higher rate of climb. Although in the early eighties some administrative changes were made, the shape of the public safety zone did not change from the original shape. A revision of the public safety zone was made in the nineties [5].

Certain changes are introduced, public safety zones take a triangle form with a few contours of individual risk (most often three 10^{-4}, 10^{-5}, 10^{-6}). Each contour represents an area in which a person resides in a period of one year is subject to certain risk of death. Their construction is based on the following models: crash frequency model, crash location model and crash consequence model. The base of the triangle is at the end of the runway and it is set symmetric with respect to an extended focal point. The base of this public safety zone consists of individual risk contour 10^{-4} and it represents the area with the highest risk of death. The airport with a public safety zone in the form of a triangle is shown in Figure 3.

Figure 3: Proposed public safety zone for the Dublin airport runway [6]

Recently, public safety zones with irregular shapes have been used and dimensioned by computer programs. An example of such a public safety zone is shown in Figure 4.

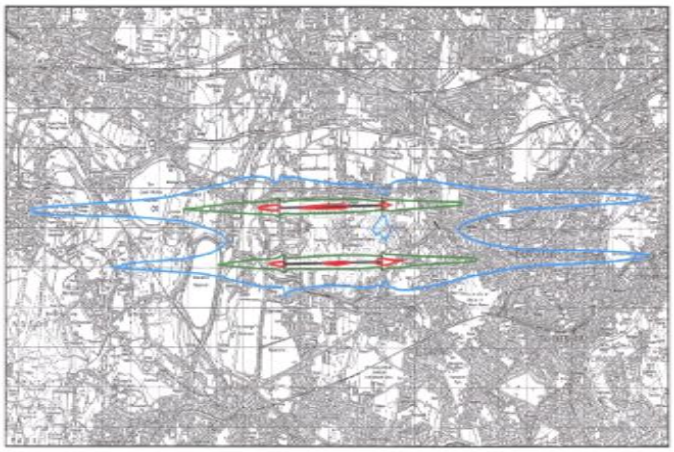

Figure 4: Public safety zone contours of Heatrow airport [4]

3. POSSIBLE OPTION FOR LJUBLJANA AND ZAGREB AIRPORT SPATIAL PLANS

Experiences have shown that when an aircraft crashes near an airport, the people on the ground come to harm. The purpose of this paper is attempt to apply British public safety zone in the case of airports Ljubljana and Zagreb.

Ljubljana Airport is an international airport handling approximately 1.5 million passengers per year, accounting 95% of air traffic in the Republic of Slovenia. It is located 26km north of Ljubljana, near Donji Brnik. It has one runway in the length of 3,300m, a width of 45m, oriented 13-31, referenced code 4E.

This paper presents the public safety zone for Ljubljana Airport, which is based on a method developed by the Ministry of environment, transport and region of Great Britain in 1997.[5] This method involves the introduction of a triangle with fixed dimensions 350m width and 3,500m length for the busier airports and $\frac{2}{3}$ of these values for airports with less traffic. The base of the triangle is located at the ends of the runway. As the document covers the busy Heathrow Airport, following the traffic data the Ljubljana Airport belongs to the category of less busy airports. Therefore, triangles in the width of 233.33m and in the length of 2,333.33m will be used. The triangle, which is at the end of the runway and which represents the contours of individual risk, is shown in Figure 5.

The analysis of Figure 5 shows that there is a number of residential buildings within the public safety zone on threshold 13, on its upper part. On threshold 31 no objects are found, except a forest.

Given the fact that the approach 13 is used as non-instrument approach (VFR), and 31 as an instrument approach (IFR), most landing operations are performed on threshold 31.

The public safety zone is without the objects but with trees in the first third in the direction of approach. In take-off direction northwest inside the public safety zone there is a certain amount of individual residential objects in the village of Senčur which is situated 1km from the end of the runway and further up to the end of zone. Within the public safety zone there are roads.

Figure 5: Contours of individual risk for Ljubljana airport

Zagreb Airport is an international airport and the busiest airport in the Republic of Croatia. It is located southeast of Zagreb, at a distance of 10km. It contains one runway in the length of 3,252m and width of 45m. The orientation of the runway is 05-23 and it is equipped with instrument landing systems on runway thresholds. According to ICAO classification and dimensions the runway has reference code 4E.

Zagreb Airport handles 2.1 million passengers yearly, similarly as Ljubljana. The public safety zone consists of isosceles triangles, in the length of 2,333.33m and width of 233.33m.

CONCLUSIONS

Most aircraft accidents happen during take-off and landing in the vicinity of airports and they represent a kind of risk for population on the ground. The analysis of aircraft accidents has proved that the risk increases approaching the runway threshold. Based on this analysis in the 1950s some western European countries produced the first study of risk assessment to third parties on the ground. The result is the construction of public safety zones which are shown in the form of individual risk contours in the figures.

Figure 6: Contours of individual risk for Zagreb airport

The triangles which represent the contours of individual risk are shown in Figure 6.

The analysis of the figure 6 of individual risk which limits the public safety zone at threshold 05, shows almost negligibly includes the residential and industrial facilities, while the threshold 23 includes residential buildings. It should be noted that in addition to residential buildings within the contours of risk at both ends of the runway there are parts of transport infrastructure.

The most common form of individual risk contours that make up public safety zone is an isosceles triangle, but it can take other forms depending on the method that is used. Depending on the degree of risk, the decision about the existing facilities located within the contour should be made.

The most radical solutions should be the removal of the existing objects and the construction of new facilities should be prohibited. For contours with the lowest degree of risk new facilities should be prohibited and current may be allowed.

Based on the British method, the public safety zone for Ljubljana and Zagreb airports was proposed and it analyzes the areas located within the contours of risk. The result indicates the need for additional research.

The public safety zones are a factor of air traffic safety, but also an important factor in spatial planning in the vicinity of airports. It is therefore recommended to study the requirement for public safety zones at Croatian and Slovenian airports.

REFERENCES

1. Aerodromes, Annex 14 to the Convention on International Civil Aviation Organization, Montreal, Canada,2009.
2. Post, J.A., Chevng, Y.S., Loog, M M.P., Weijts, J.:Analysis of Third Party Risk in the vicinity of Frankfurt Airport, National Aerospace Laboratory, 2003.
3. Pavlin, S.: Arerodromi I, sveučilišni udžbenik, Fakultet prometnih znanosti Sveučilišta u Zagrebu, Zagreb, 2006.
4. Evans, A. W., Foot, P. B., Mason, S. M., Parker, I. G., Slater, K.; Third party risk near airports and public safety zone policy, National Air traffic Service Limited, Londn, 1997.
5. Department of the environment transport and the regions;Public safety zone, A consultation document, London, United Kingdom 1997.
6. http://www.transport.ie/viewitem.asp?id=6460&lang=ENG&loc=1862
7. GfL – Gesellschaft fur Luftverkehrsforschung mbH: Third party risk posed by aircraft accidents in the vicinity of Geneva airport,2008.